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THE PANAMA CANAL

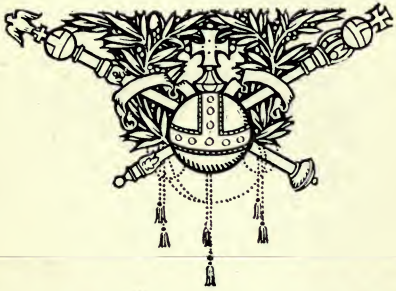
A bird's-eye view of the Panama Canal as it will appear when completed.

THE PANAMA CANAL

(ITS PAST, PRESENT, AND FUTURE)

by

C. REGINALD ENOCK, F.R.G.S.



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PREFACE

INTEREST in the Panama Canal increases as the period for the actual use of the great waterway approaches. There are now many books upon the canal before the public, and it was with some hesitation that the author accepted the commission to undertake the present work. But he ventures to think that the particular motive underlying this exposition of the theme will appeal to many, including that public which has favoured his other books with their appreciation. It is the 'human' side of the enterprise which is largely brought forward here, in addition to the matters of engineering and commercial, as well as historical, interest connected therewith. The true relationship of man to the natural resources of the globe, and their development in his interests and for his advancement and enjoyment collectively, is what, knowingly or unknowingly, modernity is seeking. We live in a privileged age; our responsibilities and our powers both are

increasing rapidly. 'Human Geography,' the true science of collective living upon the earth, is, the author ventures to submit, the coming world-science. The Panama Canal will be of value in the economic development of the world, to the extent to which this element is taken into account thereby.

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The Panama Canal

CHAPTER I

A PRELIMINARY SURVEY

PANAMA opens to the imagination a gateway towards which even the most prosaic cannot fail to turn with interest. The accomplishment of this great piece of work by restless and constructive man, one of the greatest achievements of a half-century the most remarkable in the material advancement of the world, now passes into the field of things accomplished. What were the conditions to be overcome in this work; how were they encountered; and what are the results likely to follow?—these are the questions which, briefly and simply, we are to consider in these pages.

The problem before the constructors of the canal was to cut a waterway through that singular neck of land, or isthmus, which, joining North and South America, prevented direct access by vessels between the Atlantic

and Pacific oceans. These two continents, it will be recollected, form together an enormous island. In the early days of exploration, before the geography of America was understood, it was presumed that some strait or passage between the two oceans might exist, and famous navigators, from Columbus onwards, strove to find such a waterway. They examined the whole vast coast-line of North and South America, and sailed up the rivers, such as the St Lawrence, the Mississippi, and the River Plate, which flow into the Atlantic; of course without success. There was no interoceanic passage throughout the whole length of the two continents, stretching over 120 degrees of latitude.

Thus the insistent dream of a 'strait' was never realised. Magellan, in 1521, discovered the strait which bears his name, but this was near the cold southern end of the continent, and was of comparatively little advantage. As for a way around the northern extremity of America, so difficult and useless was this that the traverse of the North-West Passage, in the Arctic, was only finally accomplished in 1905.[1] But, on Michaelmas Day, 1513, Balboa, one of the most worthy of the Spanish conquistadors, crossing the land

[1] By Amundsen, afterwards discoverer of the South Pole.

known as Darien, or Panama, found himself on the summit of a hill, with a new ocean on his horizon—the first view of the Pacific by the white man from its eastern side. Balboa called this the South Sea, because, as the Isthmus of Panama runs east and west, he was looking south. We shall consider these historical matters at greater length later on.

It was a very natural idea to cut through the isthmus, and it occurred to the earliest Spanish adventurers; but comparatively insignificant as the thickness of the neck of land is, the amount of work necessary to accomplish its severance was enormous. Yet the first consideration that may occur to the traveller, and it is a natural and philosophical one, is not the great amount of work done in cutting the Canal, but the very little that man is really able to do when confronted with hills and valleys, and the enormous expense of labour and money that is required in moving masses of rock and earth, and how small a mark such efforts really leave on the configuration of the landscape. This feeling is heightened on approaching Colon, or leaving Panama, where vast mountain chains, blue in the distance, form our horizon; and thus it is that we regard this great and praiseworthy work of human

hands in its proper proportion and a tempered spirit.

The Isthmus of Panama has been well described as a barrier between two oceans which has, nevertheless, failed to serve as a bridge between two continents. So rugged and overgrown with tropical jungle, and so subject to malarious and other disorders is this isthmus, that, despite its fame and its beauties in certain respects, this natural pathway between North and South America has been neglected as a means of transit, in a longitudinal direction, from the one to the other; and it still remains—away from the immediate influence of the canal works—almost as wild as when traversed by Balboa. The same may be said concerning great portions of South America, which remain unaltered since first aroused by the tramp of the European horseman. No railway or road traverses the isthmus connecting the two continents. The Panama Railroad crossed it transversely; an isolated link of communication in the interrupted navigation between the Pacific and the Atlantic.

We shall first consider in outline the physical conditions obtaining at Panama. As already remarked, the isthmus runs east and west, not north and south, as the position

of the two continents it joins might at first sight appear to indicate. It forms an S-curve, slightly below the tenth parallel of north latitude, with the canal slightly to the east of the eightieth meridian of west longitude. From Colon to Panama the distance across from shore to shore as the crow flies is approximately thirty-six miles, which is not quite the narrowest portion.

Had this neck of land existed under the topographical and climatic conditions of the Isthmus of Suez, the work of the Panama Canal would have been very different. Suez was a flat, sandy, and clayey plain, arid and treeless. Panama is a region of crumpled hills, heavy rainfall, and malarious jungle. Its geological formation afforded no low trough across the backbone, such as the folded strata of mountains, or even the after formation of valleys, creates at times.

In Tertiary times, or perhaps somewhat later, the isthmus as such did not exist, and, between scattered islands, waterways connected sea and sea. The hills of the isthmus, their geology shows, belong to the system of the Antilles, not to that of the Andes, and their disposition is at right angles to, not parallel with, the mountain system of North and South America—the

Andes and the Rocky Mountains and sierras. Thus before man appeared on the earth the passage was presumably open.

On the other hand, the two old river channels of the Chagres, elsewhere mentioned, filled with alluvium much below sea-level, might show that the isthmus was at one time much higher than at present; and to this view the 'drowned valleys' on the Pacific side add strength. Possibly the Chagres once discharged into the Pacific, before igneous action raised the Culebra Hill. It may be that the conditions are not yet stable.

Since the Pliocene-Tertiary period, which changed the configuration of the region, there have been no active volcanoes in the immediate region of Panama, but the whole of the Pacific coast of the two continents is subject to severe earthquake shocks, and in places to tidal waves, such as those which have destroyed Lima, Callao, Valparaiso, San Francisco, and Mexican and Central American cities at various periods. Guatemala and others of the Central American states, northwest of Panama, contain more active volcanoes than any other country, and have been greatly affected thereby. As far, however, as it is possible to judge, the immediate region of Panama is not dangerously threatened as to its stability; but what the future may

hold in this respect it is impossible to predict.[1]

The curve of the isthmus between the canal zone and the South American mainland becomes narrower at one point, measuring at San Blas only thirty-one miles. The divide or water-parting of Panama is not the lowest on the continent, moreover. Its least elevation above mean tide, before the cutting of the Canal, was 290 feet, at the Culebra Pass, on the site of the Canal. The lowest point in Central America is in Nicaragua, some 500 miles to the north-west of Panama, and is only 153 feet.

The problem of the canal, then, apart from matters of climate and disease, was to cut through thirty-six miles of ground, with a height at one point of 290 feet. Taking into account the windings of the route and the dredging necessary in the sea-bed of the

[1] While the above was in Press, two earthquake shocks, of greater intensity than any felt since the American occupation of the zone began, were experienced on October 2, 1913, lasting five and ten seconds each. The buildings in Panama were shaken and the church bells rang, wakening the inhabitants, who rushed into the streets. The plaster on the famous flat arch in the Santo Domingo Church was broken. At a point 150 miles north, great damage was done to Government buildings, church towers fell, and a submarine cable broke. But no injury befell the Canal works. There have been other shocks since that date.

approaches, this thirty-six miles was increased to fifty; but, as will be seen, it has not, in the canal as now built, been necessary to excavate for more than a part of this length.

If, as has been shown, no natural trough or depression existed across the isthmus, nature had lent some assistance in hollowing out the land. A large river, the Chagres, flowing into the sea near Colon, affords a valley which leads more than half-way across the isthmus towards the Pacific Ocean. This broad, alluvial valley, at a point twenty-six miles from the head of Limon Bay, upon which Colon is situated, turns suddenly at right angles to its general course and becomes narrow and steeper, and ceases to be of service. But this point is only nine miles from the low valley of another river, the Rio Grande, which flows into the Pacific. The water-parting or intervening ridge between the two is about 300 feet above sea-level, and is known as the Culebra Pass, and the huge excavation through it is the famous Culebra Cut, the greatest piece of earthwork that has ever been undertaken in the history of engineering. To utilise these two river valleys, cutting through the ridge to connect them, was in principle the plan of the Canal.

The first plan of the canal, as laid out by the French after the successful conclusion—

both from an engineering and financial point of view—of the Suez Canal, was for a sea-level waterway, like that of Suez. This plan, moreover, was first adopted by the Americans, the successors to the French in the work of construction, and was only changed after long consideration. A sea-level canal at Panama, whilst it was not regarded as a physical impossibility, would have involved much greater expenditure of money and time than a lock-canal. The canal as now built is therefore a lock-canal, rising by three locks at the Atlantic or Colon side, and descending by a similar number at the Pacific or Panama side: the height of these three locks lifting the vessel a total of eighty-five feet (normal) above the mean ocean level at Colon. At the Atlantic side an enormous dam creates an artificial lake twenty-three miles long, forming part of the waterway—a vast economy of excavation. The details of these matters are fully explained later on.

As before remarked, had such conditions here existed as prevail at Suez, a tide-level canal would have been carved out with facility. It is true that there is a difference in the level of the Atlantic and the Pacific oceans. On the Atlantic side there is practically no tide; the waters of Limon Bay, the debouchure of the canal, do not rise and fall more than

one-and-a-half feet. But in the Bay of Panama, on the Pacific side, there is a total tide range of twenty feet, the lowest tide falling and the highest rising ten feet above the average sea-level. This difference of level, however, need not have formed an obstacle for a sea-level canal, as it could have been overcome by a tidal lock at Panama, to control the ebb and flow.

It was not the time and expense of cutting through the ground only that determined the choice of a lock canal; there are other considerations of great importance. The Chagres River, whose valley is a natural assistance to the work, presents on the other hand certain hydrographic difficulties. It is a river subject to heavy floods, and at certain periods has been known to rise as much as thirty-five feet in twenty-four hours. This means an enormous body of water and a swift current, which would have flowed into the canal in the form of a huge cascade—an impossible condition.

The French plan to overcome this was to lead the waters of the Chagres away and take them into the sea by another channel, but this would have been equivalent to making almost a subsidiary Panama Canal. There are other rivers flowing into the Chagres, less in volume, which would have

required similar treatment. It might be a matter for surprise that in so comparatively small a watershed as that afforded by the slope of a narrow isthmus, so large a body of water could collect, but it is to be recollected that Panama is a region of heavy rainfall—the sudden severe downpourings of tropical America, which, on the Atlantic side of the isthmus, reach as much as 140 inches per annum.

Thus it is that, if the existence of rivers has rendered the Panama route the best, these rivers having themselves carried out already what is equivalent to a great part of the excavation, their presence required peculiar measures if they were not to be destructive. In the high level or lock canal the Chagres River is rendered harmless as regards its currents, on the one hand, and helpful on the other, by being impounded as a huge lake behind a great dam, this lake forming part of the waterway for a length of twenty-four miles, an inland sea nearly the size of the Lake of Geneva. Into this the torrential rivers flow, and their currents are lost in its waters, their outlet being over the regulated sluices or spillway of the dam.

It is not to be supposed that the difficulties of a tide-level canal were regarded as being impossible to overcome, or that the engineers

who conferred on the subject—engineers drawn both from Europe and America—were unanimous in favour of the lock system. On the contrary, the majority of the Board of Consulting Engineers which was called by the United States President before commencing work by the Government of that country, recommended a tide-level canal—a recommendation which was not followed, however. Under such a plan the waters of the Chagres were also to be kept back by a great dam; but the reservoir thus formed would have been above the Canal in that case, instead of forming part of the waterway. Thus it is seen that the engineers were not agreed, and other considerations determined the type of canal to be adopted. It is now generally conceded that the lock system or high-level canal was a wise choice.

Under any system of canal at Panama two features were necessary—the cutting through of the Culebra Ridge, and the dredging out of a channel, about five miles long, at each end of the waterway, to give depth for ships to enter. These two pieces of work were begun by the French engineers, and much of what they carried out in that connection was of subsequent utility and value. It has been a pleasing feature of the building of the canal by the Americans that the work of the

French, which had been held up to derision largely, has been shown in actual experience to have been effective and necessary, and praise has taken the place of former ignorant censure. Where the French failed was in lack of sanitary measures and funds, and in extravagance and corruption in disposing of funds, and in efficient mechanical appliances —not in their engineering knowledge.

It is thus seen that the first idea and purpose of a 'Strait of Panama' have not been carried out. Indeed, as is shown later, the difficulties with regard to the excavation, in the great landslides of the excavated bank of the Culebra Cut, would very probably have rendered impossible the making of a sea-level canal, or only at a cost of work altogether disproportionate. Nevertheless there are still those who argue that with an extended expenditure of money and time the sea-level canal would have been made, a still mightier chasm across the Panama water-parting. It is a question of ideals to some extent. Under its present type the canal is a 'water-bridge' rather than a canal, and the first of its kind in the history of the world. Vessels are lifted up three water-steps at one end, propelled across the connecting waterway, and lowered again three steps at the other end. The details of this enterprise, the overcoming

of the great obstacles encountered, and the purpose and utility of the canal, have been followed with increasing interest by all the civilised nations of the world, and its completion is justly regarded as marking an epoch in the history of commerce and geography.

CHAPTER II

EARLY HISTORY OF THE ISTHMUS

Before entering into a detailed explanation of the construction of the canal, and the considerations regarding its future, it will be necessary to bring to mind the main incidents in the past of the isthmian region, and of the great project of the interoceanic waterway. The history of the isthmus is the beginning of the history of America, as far as Europeans are concerned, and goes back little more than four hundred years. Columbus first sighted the land of the New World—it was a small island, which he called San Salvador, one of the Bahamas, lying slightly to the north of Cuba, and the east of Florida—on 12th October, 1492; and, on his third voyage, he reached the mainland of South America—the coast of Venezuela and island of Trinidad —on 1st August, 1498.

Fifteen years afterwards, Vasco Nuñez de Balboa traversed the isthmus and discovered the Pacific in 1513. In 1519 Cortes landed in Mexico and began the conquest of that

country. Two years later, in 1521, Magellan discovered the strait which bears his name. Three years more and Pizarro, in 1524, left Panama for the exploration of the Pacific coast of South America, and the conquest of Peru.

But these important events cannot be regarded as the beginning of the chronicles of humanity in those regions. Mexico and Central America on the one hand, and Peru on the other, were the seats of two remarkable peoples whose systems of native culture may be termed civilisations, or empires—those of the Aztec and the Inca. There were, in addition, other semi-civilised peoples dwelling in different parts of the intervening territory spanned by the isthmus. The system of laws and the elaborate temples and other structures of the native Mexican and Peruvian peoples were of such a character as astonished the Spaniards, and the question soon arose—whence did such people originally come? As time went on two schools of thought grew up concerning them.

One of these maintains that the early American civilised people must be the descendants of prehistoric emigrants from Asia or other parts of the Old World, and that the character and ornamentation of their buildings, and many of their customs

and traditions bear evidence of derivation from Mongolian, Assyrian, Egyptian, Indian, and other nations. Among those who early sustained this theory was Humboldt.

On the other hand, it is denied that any sufficient evidence of this character is forthcoming; that the arts and customs of the early Mexicans and Peruvians were nothing more than the natural reaction of man to his environment, and that their temples and laws simply followed as a natural course of evolution. The controversy on this point has been widespread, but no definite result has yet been reached.

It is, however, probable that the early American civilisations were influenced from the Old World. Those who sustain this point to the near approach of America and Asia, where, at Behring Strait, the one continent can be seen from the other in clear weather, and passage can be made in canoes; as also to the drifting over or sailing of junks from China across the Pacific to the coasts of Mexico, California, or Peru. A famous native document in hieroglyphic—the Popul-Vuh of Guatemala—speaks apparently of a 'great migration' in remote times. It would not be within our province here to enter into these matters, but it is maintained by ethnologists that, under any circumstances, America was

originally peopled by Mongolian races. The stamp of the Mongolian physiognomy may be observed by any traveller to-day, among the natives of Mexico, Peru, or elsewhere.[1]

If such prehistoric immigrants, then, did arrive in America from Asia, they may have proceeded along the Isthmus of Panama in their passage from North to South America. The classic past of America is full of interest, and the remarkable and in many cases well-preserved ruins left by these early temple builders in the lands north and south of the isthmus, will doubtless form an increasing source of attraction to travellers and students.

One of the most noteworthy features of the discovery of America is that the first discoverers did not know that they stood upon a new continent. Upon their maps 'Cathay' was the continent lying westwards across the Atlantic. Columbus to his last day maintained that it was India he had discovered. Columbus believed the world to be round, but he underestimated its size, and exaggerated in his mind the size of Asia, a view which was supported by the cosmography and cartog-

[1] The subject of the origin of the Aztecs and Incas is fully discussed, and the existing buildings illustrated in the author's book, *The Secret of the Pacific*, London, T. Fisher Unwin, 1912 (2nd edition).

raphy of the time, which had no room for another continent or ocean. It was years after the time that Balboa stood on the isthmus and looked over the 'Great South Sea' that the geographers of the Old World understood their error, and saw that America was not Asia. After that they sought insistently for a 'strait,' and the St Lawrence River in Canada was supposed to be a way to China.

The exploit of Balboa has been regarded as one of the most romantic in the history of the New World. The incident of the first beholding of the Pacific has been set down in the sonnet of Keats, beginning: 'Much have I travelled in the realms of gold,' and whose concluding line is that so freely quoted at the present time, wherein the conquistador stood 'silent upon a peak in Darien,' gazing at his companions in the 'wild surmise' engendered of the discovery. Keats, however, inaccurately substituted Cortes for Balboa.

Of Balboa much has been written. He was, although an adventurer, a 'hidalgo,' who settled in Hispaniola (Cuba), but to escape his creditors concealed himself on board ship in an empty barrel and so joined an expedition of discovery. After sighting the Pacific, Balboa descended to the

shore, waded into the water, and took 'real and corporeal possession of the sea and its shores for the King of Spain.' It was an enormous claim to make, but at the present time not a rood of that vast territory, which extended for thousands of miles on either hand, belongs to Spain.

Of the famous explorers and buccaneers of the Spanish Main and of the Pacific coast, who afterwards made the isthmus the scene of their exploits, many accounts exist. Balboa, with a train of Indians, many of whom perished under the lash in the terrible task, dragged the timbers of two vessels across the isthmus, and hoped to discover Peru, of which he had heard. He took possession of the Pearl Islands in the Bay of Panama, but the discovery of Peru was reserved for Pizarro, who had been with Balboa on the Darien hill. Balboa was foully executed by reason of the jealous action of Pedrarias Davila, one of the most ruthless of the conquistadors. Great barbarities were practised upon the Indians. The Spaniards had huge blood-hounds, and the Indians at times were thrown to them. At this period the first horseman crossed the isthmus. This was a Spaniard named Espinosa, who rode across it upon a jackass, which animal, it is recorded, 'surprised the natives so much, especially when

it brayed, that they fell on their faces and gave up their gold ornaments.'

The Isthmus of Panama became one of the greatest trade routes in the world as the Spanish colonies of the Pacific coast developed. The story of the plate ships and gold ships laden with gold stripped from the Inca temples of Peru, and with the bars of silver from the great Potosi mines of Bolivia, has often been told; and the treasure, sent to fill the coffers of the King of Spain, came perforce across the isthmus. For more than a century the rough track thereover resounded to the tramp of innumerable mule trains, laden with gold, silver, and pearls.

The name of Drake is closely associated with this region. His name has been execrated and whitewashed by turns, according to the convictions of particular historians, but the fact seems to be established that he was a man of better character than has at times been depicted.[1] Under any circumstances, he remains an undying hero, in the popular estimation, of those 'spacious days' in which he lived, and of the time of that ocean chivalry and strenuous conquest which followed on the realisation of that new horizon of America. Drake, afterwards Sir Francis, first earned his reputation under Sir John Hawkins, in actions

[1] Vide 'New Light on Drake,' *Geographical Journal.*

off Vera Cruz in the Gulf of Mexico. In 1570 Queen Elizabeth gave him a privateering commission, with which he set sail for the Spanish Main.

Later on, with a small squadron he attacked and plundered Nombre de Dios, a Spanish town on the isthmus, early implanted. With his followers Drake traversed the isthmus, and committed great depredations at Panama. In the traverse he was conducted by a *cimarron*, or fugitive slave from the Spaniards, to a hill-top, from which he obtained his first glimpse of the Pacific Ocean. It is chronicled that Drake fell on his knees and prayed that he might sail those waters on an English ship; and this he afterwards did, to his great renown. Returning to England with a reputation enhanced by what has been described as 'his success and honourable demeanour in the expedition,' he obtained the favour of the Queen, and means to sail for the South Sea. His voyage was successful. He sailed up the coast of Chile and Peru, and secured much booty at the expense of the Spaniards, among which a *navio de oro*, or gold ship, on its way from Callao to Panama. As to the morality of his proceedings, this has been fully discussed by various historians.

The Spaniards on the coast having been

thoroughly aroused by these daring exploits, Drake found that to return via Magellan's Straits, by which route he had come, was impossible, so, turning his prow north and west, he bore out into the Pacific, and circumnavigated the globe for home—the first Englishman to accomplish this circumnavigation.

Of the exploits of privateers and buccaneers in this region, volumes have been written. The term 'buccaneer' was derived from the word 'buccan,' signifying a smoke-dried meat, which was (and still is) an important article of traffic in those regions; and later the name of the makers of this commodity, or 'buccaneers,' came to have the meaning of tramp or desperado, and by various stages was at length applied to the piratical sea rovers whom they had supplied with these provisions.

Among the buccaneers the name of Henry Morgan—afterwards Sir Henry—stands paramount. Morgan early became a sailor, having, it is stated, been kidnapped in the streets of Bristol. He was born in Glamorganshire. At the age of thirty-three, with a fleet of small ships, Morgan sacked Porto Bello, a fortified town on the mainland, an exploit attended with frightful cruelties and excesses. Later he returned and attacked Panama—January,

1671—having ascended the Chagres River with his boats and men, overcoming great difficulties in the traverse of the isthmus. Again the utmost excesses marred this exploit, and have rendered the name of Morgan one of infamy.

In their march across the isthmus Morgan and his men ascended a hill, and from its summit first beheld the South Sea. The feat by which this handful of adventurers took Panama, defended by hundreds of Spaniards, if marred by excesses, was an exploit of great bravery and enterprise. It is stated that the burning of the town was not performed by the Englishmen, but by the slaves and the Spaniards. The Indians and the slaves hated the Spaniards bitterly, and were ready on occasion to take sides with the foreign buccaneers. Morgan became governor of Jamaica, and later was instrumental in suppressing piracy on the Spanish Main. The site of Old Panama—which town was destroyed by Morgan's attack—is now partly buried in the jungle, some miles from Panama, and its massive ruins form a point of interest to travellers.

The Isthmus of Darien was the scene of an episode in attempted colonisation, and the creation of a trade route by Scotsmen, at the beginning of the eighteenth century. The

interesting, although disastrous, enterprise of William Paterson and his companions may be touched upon here.

Paterson was a clever and imaginative, but erratic, economist, who, born in a Dumfriesshire farmhouse (1658), travelling to escape the religious persecution in Scotland at that time, wandered as a pedlar through England, and thence to the New World as a preacher and buccaneer by turns; he formed the astonishing design known to history as the Darien Scheme, as one act of his fertile brain, and founded the Bank of England as another. That he ever was in reality a buccaneer is open to doubt; the fact probably being that, whilst due to his intellectual and moral powers he was sought as a spiritual guide by his companions, his desire for knowledge of strange lands and happenings led to intercourse with buccaneers.

Returning to England from the Bahamas, Paterson strove to interest James II. in his Darien Scheme, which was that of establishing, by means of a powerful organisation, a settlement on the Darien Isthmus, which thus would 'hold the key of the world's commerce.' The ships of all nations were to be admitted to the projected harbour; free trade with all the world was to be maintained, and differences of race and religion were to be annulled

in this settlement. But the Government would not entertain the scheme, nor would those of Berlin, Hamburg, or Amsterdam.

Baffled for the time being, Paterson threw himself into commerce, resolved to make a fortune in order the better to carry out his scheme. In 1690 he was occupied in the formation of the Hampstead Water Company. Four years later he formulated a scheme for a Bank, under which the subscribers should lend their money to the nation, and the debt should form the bank stock. The Government required money, the plan was adopted, and the Bank of England came into being, with Paterson as one of the directors.

At this period the East India Company controlled the Oriental trade of England, by means of its powerful monopoly. But the people of the northern kingdom marked with jealousy the great industrial supremacy and wealth of England, in which they desired to share. Paterson in this saw his opportunity, and, taking his Darien Scheme to Edinburgh, he unfolded it there, and 'soon had the whole Scottish people with him.'

Scotland had previously passed an 'Act for encouraging Foreign Trade,' and in company with James Chiesly, a notorious 'interloper' —the word was first applied at this period to unauthorised traders who endeavoured to

interfere with established trade monopolies—in May, 1695, Paterson obtained a further Act of the Scottish Parliament for a franchise for a Company, with a capital of £600,000 for an African and Indian Company. The fund was immediately over-subscribed, largely by eager 'interlopers,' in London and Scotland; but, due to the jealous action of the powerful East India Company, the London subscriptions were cancelled. The Darien Scheme was not at first included in this, but formed the main issue when floated.

The ships set sail 'amid the tears and prayers and praises of relations, friends, and countrymen.' But the expedition was badly managed, and even fraud entered into it, although not on the part of Paterson. A town called New Edinburgh was established at Darien. Quarrels broke out among the council in charge, to some extent due to the methods of the fanatic Kirk party. Fever decimated the colony, and many died, including Paterson's wife and children, yet the promoters in Scotland continued to represent the enterprise as successful, and collected further large sums of money to send out other expeditions.

The Spaniards attacked the settlement; and, due to these embroilments, proclamations were issued against it by the home

Government. Finally, complete disaster overtook the colony, and, weak with fever and hunger, the survivors capitulated to the Spaniards, and marched to their ships only with the honours of war. Out of 2000 who left the Clyde, it is recorded that only a few hundreds survived. The Company failed, having lost £300,000 on this strange Scottish dream of a Darien possession and universal free trade.

The project of cutting through the isthmus to form a waterway was very early raised. Besides Panama and Darien, two other routes seemed to offer possibilities—those of Nicaragua and Tehuantepec in Mexico, now crossed by a railway. In 1550 the Portuguese navigator, Antonio Galvao, published a book to show that a canal could be made at any of these places; and in 1551 Gomara, the Spanish historian, urged Philip II. in forceful terms that such a project should be carried out.

But the project did not meet with the favour of the Spanish Government. A passage by sea to Cathay or China was regarded as of less importance than the monopoly of communication with the colonial possessions which Panama ensured, and the comparative security the barrier of the isthmus afforded; and it was even forbidden under pain of death

to seek or make known any route between the oceans beyond that across the isthmus to Panama. It was even represented to Philip by the Church, that 'if the Almighty had intended there should be a waterway across the isthmus one would have existed naturally.' With the exception of the disastrous scheme of Paterson in 1698, the project for a canal remained unconsidered. But in 1771 other ideas grew to being, and the Spanish Government caused a survey of the Tehuantepec isthmus to be made. This route was found impracticable, however, and in 1779 surveys were made of the Nicaragua route, but the project, owing to political disturbances in Europe, did not develop.

The region of Central America, as concerns the history of projected canals, has association with the famous Nelson, the hero of Trafalgar, at this period. Nelson was indeed one of the controlling spirits of the vast military and naval drama, which, after filling for more than two years the immense stage bounded by Europe and the West Indies, found its closing scene in Trafalgar Bay. It was in Nelson's first active service that he went upon an expedition to San Juan de Nicaragua in 1780, and where he was brought almost to the point of death by fever contracted in that deadly climate, and

was invalided home. This expedition had followed on a survey of the Nicaragua route for a canal by Spain. The project was unfavourably viewed by the Spanish government, who had authorised the survey, but two British agents had accompanied the Spanish commission which made the report, and these agents represented to the British Government, in a secret communication, that the undertaking was possible.

When war was declared by Spain against Britain, the British Government decided to send an expedition, doubtless influenced by the secret report, to Nicaragua, to invade that part of the Spanish colonies, and Horatio Nelson it was, then a post captain in the navy, who was chief of the naval operations. In his despatch from Nicaragua, Nelson gave a favourable account of the possibilities of an inter-oceanic waterway. He stated his intention of occupying Lake Nicaragua, which he regarded as 'the inland Gibraltar of Spanish America,' commanding the water pass between the Atlantic and the Pacific, the possession of which would, in his view, divide Spanish America into two parts.

But the British expedition and these designs were overcome, not by the Spaniards, whom the British expedition defeated completely, but by the forces of nature, represented

by the rainy season and the fevers which accompanied it. It is stated that of the crew of Nelson's ship of 200 men, 190 perished and were buried in Nicaragua, whilst Nelson's health was permanently injured.

In 1808 the matter of a Nicaragua canal was again brought forward by Alexander von Humboldt, who examined the isthmus and indicated its possibilities. Following upon this, after the independence of the colonies of Spain in the New World was established, and the onerous conditions as regarded commercial movements in those regions which the policy of Spain maintained were abolished, various concessions were applied for by promoters of different nationalities, with the purpose of building an interoceanic canal. Prominent among these were would-be concessionaires from Great Britain and the United States, as well as from France, Belgium, and Holland; but nothing practical was accomplished, although events were shaping toward the exploitation of the project.

CHAPTER III

MODERN HISTORY OF THE CANAL

THE more modern period of activity on the Isthmus of Panama may be said to have begun with the discovery of gold in California and Oregon. This was in 1849. Early in the nineteenth century, the colonies of Spain in America had revolted and become independent. It was to a large extent due to the oppressive commercial policy of Spain in her colonies that these were lost to her, and the formerly busy towns of the Isthmus of Panama settled into lethargy. But the rush of prospectors and gold-seekers from the eastern part of the United States and from Europe to the new goldfields of California called for some easy means of transport from east to west. There were no railways across the immense North American continent. The route of the 'prairie schooner' across the great deserts of the American west was mapped out by the bones of pioneers, fallen by reason of the attacks of Indians, of drought and fatigue. Thousands went that way, and thousands went around Cape Horn.

At that period the great Pacific coast of America was little frequented by Europeans, whose trade with the ports of China was more considerable. San Francisco and Valparaiso both were isolated and remote. San Francisco was, however, a growing and important centre. California had become a possession of the United States, which country from its small beginnings on the Atlantic coast of New England was developing into the giant which it rapidly became, under the influence of immigrating humanity, and invested gold from Britain and the other countries of Europe. Instead of remaining the property of New Spain, or part of the empire and afterwards republic of Mexico, California fell to the United States. It just escaped being a British possession.

The route across the continent being arduous and long, and that via Cape Horn long and stormy, the way across the Isthmus of Panama came into favour, and an incredible number of people journeyed thereby. The route lay by boat from New York to the little town of Chagres, at the mouth of the river of that name, and thence upstream in native craft, drawing but little water, to Gorgona or Cruces, at the head of navigation some twenty miles from the coast. From this point the old Spanish road conducted the emigrant to

Panama, over the high divide of the Culebra Pass.

In the dry season this was not necessarily a difficult undertaking, although food was bad, and there were no hostelries worthy of the name for the emigrants, who at times numbered as many as three or four thousand in a single day, going or returning. But in the rainy season the hardships were great. The Spaniards were not road-builders. Many parts of Spanish America are in the same condition to-day as regards lack of roads as they were at the time of the conquest.

The execrable trail across the isthmus was at times impassable, and hordes of passengers, exposed to the heavy rains, and to fevers and hunger, were compelled to spend seven or eight days in crossing the forty odd miles from port to port. Those who are acquainted with the 'roads' in Spanish American travel to-day can best picture the conditions then obtaining. Loaded mules leapt from boulder to boulder, and the passenger, divided between the fear of cholera, malaria, and yellow fever, and the attacks of the mosquitoes, struggled along in the mud when saddle-animals were not obtainable, often abandoning their baggage.

The old Spanish city of Panama was

invaded by a low class of American saloon keepers, in which gambling, drinking, vice, bowie-knives, and revolvers were prominent features. Hatred of the invading foreigners, who were largely judged by this low 'Yankee'[1] element, grew up in the minds of the Spanish-speaking people of Panama, and various disturbances took place, attended with bloodshed. The Latin-American people, such as those who then formed the Republic of New Granada, or Colombia, of which Panama was a province, however much they are misgoverned, have certain claims to culture, and this was greatly outraged by the American invasion.

But if the Americans lacked culture they did not lack energy and enterprise. The Panama Railroad followed as a natural result of the traffic across the isthmus, and indeed it had been conceived before the Californian gold fever in 1848. A concession was obtained by some Americans from the Government of Bogota, in 1850, and in 1855 the first locomotive crossed the jungle railway, amid the tangled forests and unhealthy swamps. Colon and Panama grew more rapidly. Colon has been described as one of the wickedest places

[1] The term 'Yankee,' of course, really refers to the Americans of the Eastern States, but is generally applied in its Hispanicised form of 'Yanqui' to all Americans of the United States.

in the world, and possibly merited the description until recent times.

The engineers of the line, and the men engaged upon its construction, suffered terribly, especially from the fevers and bilious disorders of the climate. The sufferings and death of the greater number of the 800 Chinese who were imported by the railway company as labourers on construction work, who embarked from their own country for the new land without any knowledge of the conditions which awaited them, are among the most terrible and pathetic in the history of Panama. It is stated that many committed suicide. Crowds of laborious peasantry from Ireland shared almost a similar fate; and hordes of negroes followed. Races from all parts of the earth—Spain, Mongolia, Africa, Britain, India, and all else, of every kind of faith and language, were mixed together in this work, and their descendants to-day are shown in the extraordinarily mixed population of the isthmus. The region produced absolutely nothing of material, food, or resource, all of which came from New York. There is a tradition that every sleeper or tie on the railway represented one human life lost—naturally an exaggeration.

Some 7,000,000 dollars, equal to about £30,000 per mile—an enormous figure for a line

of that character—were spent. But so considerable was the traffic that nearly one-third of this cost was repaid before the line was complete; and for years a high dividend was paid on its operations, reaching as much as 24 per cent. per annum.

In 1860, however, a decline set in, due to extortionate freight and passenger rates, and the consequent competition of the Pacific Steam Navigation Company of London, which took the business of the railroad to a considerable extent, with its large steamers from Liverpool to the Pacific coast. A further adverse element was the opening of the Union Pacific Railroad, giving rail communication across the continent from New York to San Francisco. Following this was a period of corrupt management; and the line deteriorated, until, according to an American writer, there was 'little left of the road beyond two streaks of rust.'[1]

The project of a waterway now comes more prominently forward. Between 1870 and 1875 the United States Government sent out various expeditions for the purpose of examining the different routes across the several isthmuses or narrow, low portions of Central America, whether of Darien, of Panama, or of Nicaragua. The Darien and Panama

[1] *Panama*, by Albert Edwards.

Isthmus had as many as nine possible variants or sites, over which it had been held that the canal might be built. The result of the examination was to establish the fact that the only lines possible for a waterway without the impossible adjunct of a tunnel, were those of Panama and Nicaragua.

The Panama route has as its width across, 35 miles, and the greatest height of the continental divide is about 300 feet. At Nicaragua the distance is about 156 miles, with a greatest height of 160 feet. One-third of the Nicaragua route is covered by a lake, whose surface is 105 feet above sea-level, connected with the Atlantic by a navigable river. At Nicaragua only a lock canal was feasible, whilst at Panama a tide-level canal was a physical possibility, or so it was considered.

The plan of cutting the isthmus had appealed to many. Humboldt wrote that the construction of a canal might 'immortalise a government occupied with the true interests of humanity.' Goethe, even, in 1827, dwelt on the necessity for the effecting of the work by the United States, and wished he might see the day it should be done, and in addition that he 'might see England in possession of a canal through Suez'—almost a prophecy. Of the various schemes of that time account

cannot be given here. The American Government had at first taken comparatively little interest in the subject except that from time to time they complained that the Monroe Doctrine might be outraged. However, the scientific surveys carried out by the American Government were the first to establish exact knowledge of the condition to be encountered.

By the Clayton-Bulwer treaty, made in 1850, between the United States and Great Britain, by the treaty of 1846 with New Granada (or Colombia), and by the treaty of 1867 with Nicaragua, the international status of the canal project was established, the United States guaranteeing that such a waterway, whether in Panama or Nicaragua, should be neutral, and furthermore, that it should be used and enjoyed upon equal terms by the citizens of both countries.

It is to be recollected that the only possible terminal of an interoceanic canal in Nicaragua was within territory under the control of Great Britain, that of the Mosquito Coast, the monotonous and swampy shore of the Caribbean. From 1655 to 1850 a protectorate was claimed by Great Britain over the Mosquito Indian of this coast. The first white settlement was made in 1630 by the agents of a British Chartered

Company, whose chairman was the Earl of Warwick, and treasurer John Pym; and two small cays were occupied.

The colony was not very successful. The protectorate was disputed by Spain, Central America, and the United States. Greytown, or San Juan del Norte, was seized in 1848 by the Mosquito Indians, with British support, and great excitement was aroused in the United States, with risk of war. But both powers, under the Clayton-Bulwer treaty, pledged themselves not to fortify, colonise, or exercise dominion over any part of Central America; and in 1860 Great Britain concluded a treaty with Nicaragua, transferring the suzerainty of the Carribean coast to that republic.

It may have been natural to some extent for Americans in the past to have questioned British rights on that coast, and indeed the voice of Britain in the matter of a canal at all has been questioned by a certain jealous or Anglophobic class of Americans. But Great Britain, with her vast interests in the West Indies and Canada, involving an area of territory at least as large as that of the United States, to say nothing of her vast world-commerce, could scarcely, under any common-sense principle, be regarded as an interloper in a field so vitally affecting those interests as that of a Central American Canal.

Panama was originally a part of the viceroyalty of New Granada, created in 1718, and in 1819 it became part of the independent republic of Colombia, and in 1831 of New Granada. In 1841 the Panama and Veragua provinces seceded from the republic, and, with a very short life, became the State of the Isthmus of Panama. In 1857 it again seceded, but soon returned. It had neither population nor resource sufficient to constitute a separate state.

The treaty of the United States with New Granada in 1846, granted transportation facilities on the isthmus for the United States, which was preparing for war with Mexico—a war which the Mexicans have termed the 'unjust war,' and in which they lost enormous areas of territory, including Texas and other states. Under the treaty, the United States guaranteed the sovereignty of New Granada on the isthmus, and this has been considered the first step towards the establishment of an American protectorate over the isthmus. It only became possible for the United States to build and control an interoceanic canal by the negotiation of the Hay-Pauncefote treaty, and it is necessary to recollect these developments in view of the attitude of the United States in 1912–13 towards Great Britain in the matter of canal dues, discussed elsewhere.

It is interesting to glance back for a moment and observe the effect which the long sea voyage around Cape Horn had upon the development of the Americas. The separation of the east and the west of North America was long kept up from this cause. To the enormous territories of California and Oregon the right of Great Britain was as tenable as that of the United States, but their remoteness weighed against early British occupation. Even had Britain not resisted the insistent American cry, under President Polk, of 'Fifty-four fifty or fight'—that is, that the parallel of 54° 50′ should be accepted, or else war would be declared against Great Britain—and insisted on the 49th parallel, which was mutually accepted as the southern boundary of western Canada in 1846, the greater part of British Columbia and the extraordinarily rich wheat-growing provinces of Western Canada would have been lost to the Empire. Even to-day the enormous rainless deserts which separate California from the middle portion of the United States render the development of the west slower than the east, and almost sever the United States into two countries.

CHAPTER IV

INFLUENCE OF THE SUEZ CANAL

In the sequence of events connected with Panama the Suez Canal has an important place. By the genius primarily of one man, the continents of the Old World had been severed, and the circumnavigation of Africa rendered unnecessary for vessels to which the route of Suez offered a shortening of their voyage. The work of Ferdinand de Lesseps at Suez had been crowned with success, both from an engineering and financial point of view, and there are many points of analogy between Panama and Suez. Attention will be devoted to these in the present chapter.

From very early times projects for a waterway uniting the Red Sea and the Nile had existed. The legendary Seostris, according to Aristotle, Strabo, and Pliny, was the first builder of such a canal, and from an inscription on the temple of Karnak, it would appear that in 1380 B.C. it existed. In the eighth century A.D. the idea of a Suez Canal was

entertained by Haroun-al-Raschid, who, however, abandoned the scheme, fearing to lay open the coast of Arabia to the Byzantine Navy. At the close of the fifteenth century, the Venetians, who had for hundreds of years predominated in trade with the East, via the Red Sea and Egypt, treated with Egypt for an Isthmian canal, but the Turkish conquest of Egypt destroyed the project. Leibnitz, in 1671, and the Sheik Balad Ali Bey, in 1770, were others who considered such a canal.

In 1798 Bonaparte, in Egypt, ordered a survey of the route. The engineer who accomplished this stated that there was a difference of level between the Red Sea and the Mediterranean of twenty-nine feet, which, however, was disproved by the surveys of the *Société d'Études pour le Canal de Suez*, in 1847. This society was established by the Saint Simonist Enfantino, whose scheme for a canal across the Isthmus of Suez, like the canal across the Isthmus of Panama, was part of the Saint Simonist programme of Socialism for the regeneration of mankind. It was an early scheme of the Count of Saint Simon to join the Atlantic and the Pacific by a canal. Thus the projects of both the great isthmian canals were early advocated by Socialists and visionaries.

Some years passed without any advance being made in the Suez scheme, until, in 1854, Ferdinand de Lesseps appeared, imbued with the great idea. Lesseps had been associated with the Saint Simonists and had for some time taken keen interest in the conception. The acceisson of his friend Said Pasha to the viceroyalty of Egypt gave Lesseps his opportunity, and he obtained a concession to form a company to build the canal. The concession was amplified after surveys had fixed the exact route; it was to last for ninety-nine years from the date of the opening of the canal, after which, in default of other arrangements, it would pass to the Egyptian Government. In connection with the surveys, the name of Alois Negrelli of Tyrol must not be forgotten; whose plans were bought by de Lesseps.

The concession required confirmation by the Sultan of Turkey, but Lesseps, repairing to Constantinople to obtain this, was confronted with and baffled by British diplomacy. Proceeding to London he was informed by Lord Palmerston that the project for a canal was regarded by the British Government as a physical impossibility; that it could not be constructed. Furthermore, if it should be made, the Government's contention was that it would tend to injure

British supremacy, and that the project was probably only a French device for interference in the East. Thus history repeated itself; the British Government taking up an attitude in regard to the Suez waterway, in the middle of the nineteenth century, almost analogous with that of the Spanish Government concerning Panama in 1551.

Lesseps obtained the Sultan's confirmation of his concession in 1866, but previously, in 1858, opened the subscription lists of the company. The capital was to be 200,000,000 francs, in 400,000 shares of 500 francs. More than three-quarters of the shares were taken in the first month; 200,000 of them in France, and 96,000 in the Ottoman Empire. England, the United States, Austria, and Russia, however, would have nothing to do with the shares. The viceroy took 85,500 shares, and these formed part of the 176,582 shares which, under Lord Beaconsfield, were bought for the sum of £3,976,582 by England from the Khedive in 1875.

The purchase of these shares proved, as is well known, an excellent transaction for England. At the time it was received with great applause in Britain, and was regarded as a courageous act, and Disraeli received much congratulation therefor. But it was not a conception of Disraeli's. The knowledge

that the Khedive's shares were to be sold, and were likely to pass into the hands of a French syndicate, was suddenly acquired and communicated by the editor of a London newspaper[1] who went to Lord Derby at the Foreign Office; and, in the face of certain red-tape difficulties, a telegram was sent to the British Consul-General at Cairo and the purchase effected. Thus it was by a mere stroke of good fortune that Britain acquired her large interest in the Suez Canal.

The first spadeful of sand for the construction of the waterway was turned on 25th April, 1859, near the site of Port Said. The formal opening took place ten years afterwards, in November, 1869. The total length of the canal navigation from Port Said on the Mediterranean, to the Gulf of Suez on the Red Sea, is 100 miles, and there are no locks, the waterway being entirely at tide level. The Isthmus of Suez, like that of Panama, runs east and west, and the general trend of the Suez Canal is north and south. Various lakes are crossed. At the northern or Mediterranean side, Lake Menzala is crossed for about thirty miles, and the canal was formed in this section by dredging. The Bala, Timsa, and Bitter Lakes, strung out to the south, are

[1] The *Pall Mall Gazette*, Mr Frederic Greenwood, 15th November, 1875.

crossed by the canal, the last named occupying about twenty-five miles.

The work was divided into four contracts; the first for 250,000 cubic metres of concrete blocks for the Port Said jetties; the second for the first 60 kilometres of channel through Lake Menzala, where 22,000,000 cubic metres of soft sand and mud were excavated; the third was for a length of 13 kilometres, and involved the cutting through the high ground of El Gisr, which, composed mainly of loose sand, rose 60 feet above the sea; and the fourth, the section between Lake Timsa—about midway—and the Red Sea.

The material was, in general, easily removed, but rock was encountered at a few points. Several new kinds of dredgers were evolved by the contractors; that used at El Gisr being practically a bucket-dredger for working in the dry sand, with an arm projecting downward from an engine on the bank, carrying a continuous chain with buckets, which scooped out the material below and discharged into wagons on the bank.

The canal was at first built with a depth of eight metres, and a bottom width of twenty-two metres, but these dimensions were subsequently increased to a depth of nine metres, with a minimum width of sixty-

five metres on the tangents (or straight parts) between Port Said and the Bitter Lakes, and of seventy-five metres between these and Suez, increasing to eighty metres on the curves. These widenings greatly facilitated the passing of ships, which became possible at any point. Navigation is permitted at night to ships having electric searchlights, and the time of transit, which in 1886 occupied thirty-six hours, has been reduced by half. Ten kilometres per hour is the maximum speed permitted.

Considerable financial difficulties marked the building of this canal, and that of its subsidiary works. At first the work was performed by forced native labour, at pay somewhat better than the ordinary, but this system was disapproved by the British and Egyptian Governments, who prohibited it. The company objected, but were informed that the work would be stopped, and at length arbitration was entered into, under the Emperor Napoleon III. The abolition of the forced labour, which followed, appears to have been the salvation of the enterprise, for mechanical appliances and modern engineering methods were introduced or evolved to replace it. Further funds were raised under loans and by other methods, including a lottery

scheme, and the sale of part of the subsidiary property.

At the date of opening, in 1869, a total expenditure had been incurred of 432,807,882 francs. The International Technical Commission in 1856 had estimated the cost at less than half this amount, for a larger canal, or 200,000,000 francs. Thus the inevitable underestimating took place. With the Empress Eugénie on board, the *Aigle*, leading sixty-eight vessels of different nationalities, began the passage on 17th November, arriving at Suez on the 20th. In the following year 500 vessels used the canal, but the receipts for the two first years did not cover the operating expenses. A loan for 20,000,000 francs in 1871 failed, but the enterprise was saved from bankruptcy by a rapid increase in its takings.

The dues charged on the canal were adjusted at various periods. In 1884 British shipowners agitated against what they regarded as excessive rates, and threatened to construct a second canal if they were not lowered. After a meeting between them and the canal owners, it was agreed that the rates should be lowered from 10 to 9½ francs a ton, with further lowering on a sliding scale as dividends increased; all surplus profits after 25 per cent. was paid to be applied to such reduction

until 5 francs a ton should be reached. In conformity with this plan, the dues were fixed at $7\frac{3}{4}$ francs per ton at the beginning of 1906; with ships in ballast at reduced rates, and passengers at the original figure of 10 francs each. In 1912 they were further reduced to 6·25 francs per ton.

Under the original concessions the tolls on the Suez Canal were to be the same for ships of all nations, without preferential treatment of any nature; the canal and its ports to be open '*comme passages neutres*.' A national agreement to this effect, however, was found necessary as a result of the four days' suspension of the canal by order of Sir Garnet Wolseley during the Egyptian crisis of 1881–2, who was in command of the British forces; and in October, 1888, the European Powers signed the Suez Canal Convention, setting forth that the canal should 'always be free and open, in time of war as in time of peace, to every vessel of commerce or of war, without distinction of flag,' with some slight discrimination, however, as regarded the position of affairs in Egypt at the time. In 1904, under the Anglo-French agreement, the stipulations were unconditionally ratified without exceptions. Under this agreement the Russian warships in 1904–5 used the canal, but passage was prohibited to Spanish warships

in 1898, during the war between the United States and Spain.

Ferdinand de Lesseps was a man of great determination imbued with strong faith in his conceptions. Notwithstanding the discouragement of his critics, who averred that the force of the sea at Port Said would fill the end of the canal with mud, and that the desert winds would stuff the trenches with sand, he persisted in his propaganda. Furthermore, it is to be recollected that at the time there were no mechanical appliances such as to-day have rendered canal excavation relatively easy; and—apparently a still more adverse condition—no steam mercantile marine to use the canal when it should be made.

No adverse arguments could dishearten Lesseps. Impressed by the talent and conviction of the great Frenchman, Napoleon III. and the Empress Eugénie supported him strongly, and so stirred up the patriotism of the French nation, that 200,000,000 francs, or more than half the required capital, were rapidly subscribed. Lesseps was born in 1805, and had nourished the idea of the Suez Canal for twenty-two years before he was in a position to begin the work. His early career was that of a diplomatist, and he was not an engineer.

The increase in the traffic through the Suez Canal during the last few years has been very considerable, due to some extent to the development of the Far East with the aid of foreign capital. For the year 1911, the net burden of vessels using the canal was given as nearly 18,500,000 tons, and more than 275,000 passengers. For 1912, the number of 5373 ships passed the canal, with a net burden of 20,275,000 tons. This represented a growth in ten years of over 70 per cent. in the shipping which used the waterway. The comparisons in point of distance between Suez and Panama are given subsequently. A map of the world invites interesting reflections. The difference of longitude between the two canals and their distance from each other, is in reality less than one-third the circumference of the globe.

CHAPTER V

THE WORK OF THE FRENCH

THE completion and success of the Suez Canal as a commercially paying enterprise inevitably attracted renewed attention to the American isthmus. What had been done in the Old World could, it was argued, be done in the New. An association was formed in Paris in 1876, with the name of Societé Civile Internationale du Canal Interocéanique, for the purpose of making explorations and surveys of a ship canal, and an expedition under Lieutenant Wyse was sent out to examine the Panama route. In the name of the Association a concession was obtained from the government of Colombia, known as the Wyse Concession, under which the work of the Panama Canal has been done.

In May, 1879, a congress at the Geographical Society at Paris was convened of 135 delegates from various nations; some from Great Britain, Germany, and the United States, but the majority from France. Some doubts have been cast on the 'scientific' character of this

congress, as out of the total delegates only forty-two were geographers or engineers, many of the remainder being speculators and politicians.

The congress, after two weeks' deliberation, voted in favour of the Panama route and a sea-level canal; and Lesseps was declared by public opinion the proper head of the enterprise. Notwithstanding his age, which was 74, the veteran undertook the work. Lesseps had undoubtedly been blinded to a large extent by the remarkable success of his Suez enterprise, which had rendered him absolute in his opinion and despotic in his temper, brooking no opposition. That 'the canal will be made' was his sincere belief, and the answer he returned to all adverse opinion.

Following upon this, the Panama Canal Company was organised under the laws of France, and the Wyse concession was purchased for the sum of 10,000,000 francs. Probably the unscrupulous company-promoting element was one of the strongest in the affair, save the faith of Lesseps in the final result. However, patriotism was appealed to. The first attempt to float the company failed, but success was attained in 1888, and 1,000,000 shares of 500 francs each were sold. Stock-gambling immediately took place, the market

being 'rigged' to serve the ends of the company promoters. At one moment it was represented that the United States was, under the Monroe Doctrine, showing an adverse front to the enterprise, so bringing down the stock; at another, misquotation from the President's Message that the Americans favoured it, sent the shares up. In reality the Americans did not view with favour a Europeanised canal at Panama.

The two following years were occupied with surveys and preliminary work; and the effects of the climate became apparent. The plan of the canal as laid out was of a sea-level waterway having a depth of 29½ feet and a bottom width of 72 feet. This called for an excavation of material estimated at 157,000,000 cubic yards; and the cost was calculated by Lesseps in 1880 at 658,000,000 francs, and the work as requiring eight years. The condition of anchorage at Colon and Panama determined the respective terminii. From Colon the canal was to traverse low ground for six miles to Gatun, at which point the Chagres river valley was entered; to pass up the valley, as before described, for twenty-one miles to Obispo, where the Chagres valley would be left and a tributary—the Cumacho—followed; to cut through the Culebra Pass, the water-parting of the isthmus, and from

that point to follow the valley of the Rio Grande to the Bay of Panama.

From deep water on the Atlantic to deep water on the Pacific the distance was forty-seven miles. The sharpest curve had a radius of 6200 feet. The proposed line was practically that followed by the Panama Railroad, and as a monopoly of that route had been already granted, it was essential in using the Wyse Concession that an agreement should be entered into with the American railway company. This was effected by buying out the railway at the enormous price of 25,500,000 dollars.

The difficulties attending the making of a canal at sea-level have already been outlined; both that due to the enormous excavation at Culebra, and that consequent upon the hydrographic conditions of the River Chagres. But Lesseps would hear of none other. The plan of Suez he vowed to follow. In 1879 he visited the isthmus, observed the rocky backbone of Culebra, and the river flowing from it, and seemed to think that to speak was to accomplish.

A man less influenced by success—or even had he been an engineer—would have made some compromise with nature, and substituted a lock canal; but the Count was inflexible, and his little daughter, who accompanied him, gave, on the first day of January,

1880, the initial *coup de pioche*, or blow of a pickaxe, which amid ceremony and enthusiasm, surrounded by officials, and with the special blessing of the Bishop of Panama, inaugurated the work which was to 'contribute to the union of two oceans for the good of humanity.'

This accomplished, Lesseps, after a few days on the isthmus, went to the United States, to endeavour to allay the American feelings which, under the working of the Monroe Doctrine, had suffered unrest. Glowing accounts of all these occurrences were published by the active promoters in Paris, and their operations on the Bourse were duly influenced. Much money was spent, then and afterwards, 'in purchasing the silence of voices which would otherwise have been raised against a Europeanised canal.' The expenditure under the Lesseps plan was enormous. The management was 'characterised by a degree of extravagance and corruption rarely if ever equalled in the history of the world.'[1]

In eight years this expenditure amounted to 300,000,000 dollars; more than three times the sum for which the Suez Canal was constructed. Exorbitant prices were paid for moving soft material, and the harder work was neglected: cheating by contractors was rife. Nevertheless the excavation of the

[1] *Encyc. Brit.*, Panama Canal.

Culebra Cut was carried on by the French contractors organised by M. Bunau-Varilla, that faithful champion of the canal, and this has proved of permanent utility; as has the dredging at the Atlantic entrance, which was let to an American contractor. Further, numerous young French engineers, with the utmost care and diligence, carried out surveys and made maps, working with enthusiasm in the fever-stricken jungle, and literally earning reputations or the grave, for the deaths from yellow fever and malaria grew terribly.

It was not that the plan of a tide-level canal was physically impossible, but that the cost had not been counted beforehand; the appliances of the period were insufficiently developed, and, perhaps more than all, the ravages of disease weighed against the heroic French. The Director of Works himself fell ill; two talented engineers who came out together from Paris to take high posts were together carried to the cemetery within fifteen days of their arrival. A famous prospectus-writer and advocate, who came out on the part of the promoters to report upon the great work, died of yellow fever; and, from data left by the French, it was shown that the death-rate at one period reached 176 per thousand. Out of each hundred individuals who arrived on

the isthmus, it is stated that, on an average, only twenty were able to be at their work.

This unequal struggle ended in 1888. The indomitable fight carried out by the men on the isthmus against natural forces and climatic disadvantages, and the unscrupulous machinations of the sharemongers in Paris, both failed; and what, as regarded its finance, was to a large extent a 'bubble' burst, and brought ruin with it. A great deal of the paper stock was held by French peasants and people of very moderate resources. A great scandal resulted, in which Government officials were implicated, and the unfortunate Lesseps became practically insane under the shame. The winding-up of the bankrupt company was declared in December, 1888. Political capital was made of the affair; the adversaries of the French Republic, seeking for a scandal that would imperil the Government, hoped to bring about the prosecution of the Directors of the Panama Company; and their attacks were so vigorously made that the Government was obliged, in self-defence, to have judicial proceedings taken against Ferdinand de Lesseps, his son Charles, and his co-workers. Charles de Lesseps, a victim offered to the fury of the politicians, tried to divert the storm upon his own head to save his father.

Ferdinand de Lesseps was a member of the

French Academy, the Academy of Sciences, and other scientific bodies; holder of the Grand Cross of the Legion of Honour and of the Star of India, and had received the freedom of the City of London. He was a man of honour and courage; far from having enriched himself whilst others were ruined, he died poor, in 1894. His statue stands at the entrance of the Suez Canal, which great waterway is his true monument.

Before the close of 1887 it had become evident to the French company that a sea-level canal could never be constructed with the resources at their disposal, and the plan was changed to that of a lock canal, and work continued on that basis until the winding-up order by the Tribunal Civil de la Seine. The court appointed a liquidator to hold the property. Work was suspended, and the force dispersed; M. Bunau-Varilla being among those who remained and kept his faith in the 'Strait of Panama.'

But work was undertaken to determine the question of the possibility of the canal's construction. There were more than 200,000 shareholders, many of them poor, who could ill afford to lose by the failure of the enterprise, and the receiver appointed a commission of French and foreign engineers to consider the situation. In 1890 this commission reported

that a lock canal could be built in eight years at a cost of 580,000,000 francs, or 900,000,000 to include financing and administration; that the plant in hand was in good condition; and that the value of the work done and plant installed was 450,000,000 francs.

An extension of the Wyse Concession was secured, under heavy subsidies to the Colombian Government, and the date fixed for the completion of the canal as October, 1910. A second or New Panama Company was organised in 1904, under French law, of a semi-national character, with a capital stock of 650,000 shares of 100 francs each, of which 50,000 belonged to Colombia. It took over all the rights and property of its predecessor, and the shares in the Panama Railroad, which latter retained its separate organisation as an American corporation, the shares in this being held in trust for the benefit of the company. The engineering question had thus apparently been satisfactorily solved.

The plan adopted was for two levels above sea-level, one of them an artificial lake, to be made by a dam at Bohio, reached by a flight of two locks, and the second by a further flight of two locks, the highest being 102 feet above sea-level, supplied with water from a reservoir on the upper Chagres. The depth of the canal was

to be 29½ feet, and its width 98 feet at the bottom; with locks 738 feet long.

But the financial aspect was less satisfactory, and had indeed suddenly become difficult or insoluble by the advent of the United States with a proposed rival canal. The control of a canal at Panama by Europeans was not a pleasing prospect for the people of the United States. Since 1876 the Nicaragua route had been favourably considered, and the project to build a canal now assumed a partisan character, and a practical movement was made. A treaty had been entered into with Nicaragua in 1884, but on coming up for ratification in the American Senate in 1885 had not received the necessary two-thirds majority. A concession was obtained, however, by a private New York company in 1887 from Nicaragua, and incorporated by act of Congress.

Work to build a canal was begun in June, 1889; excavation was performed on a channel 3000 feet long, 17 feet deep, and 280 feet wide, near Greytown, and a line of 11 miles of railway, and a pier built, all at an expenditure of 4,500,000 dollars. But the financial disturbances of that time brought bankruptcy upon the company, and the work was stopped. In 1895 the American Congress appointed a Board to report upon the subject; and again

in 1897, and serious criticism of the work done was made by this, and changes advocated in the plans. The matter was still under consideration when the revival of the Panama plan took place, and in 1899 the Isthmian Canal Commission was created. Meanwhile the concession of the company in Nicaragua was declared forfeited to the Nicaraguan Government, and the property fell into decay.

The matter of an interoceanic canal in Central America was not, at that period, of more interest to the United States, or more necessary to them, than to any other maritime nation. But what of popular interest in the subject existed received an enormous impulse by the Spanish-American War of 1898. From that sprang the conviction, almost an article of national faith, that a canal must be built. The Atlantic and Pacific shores of the United States are enormously separated by sea; the whole of the South American continent being circumnavigated in reaching the one from the other, by the ships of the navy or the mercantile marine.

This geographical fact was suddenly accentuated by the famous voyage of the *Oregon*, an American battleship of small but new type of that period, which was lying at San Francisco, and which was ordered to Key West in Florida. The voyage round

South America involved more than 13,000 miles of steaming. For several weeks the people and press of the United States were in a state of apprehension whilst the gallant vessel made her journey. For weeks she was unheard of, and it was feared she might have been intercepted by the enemy or foundered, and great relief was experienced when she touched at a North American Atlantic port. The voyage of the *Oregon* has become one of the classic incidents of American naval history. That 'the canal must be built,' and furthermore that it 'must be under American control' became the popular cry throughout the United States.

The project did not present itself to the Americans as solely a business enterprise, upon which dividends might be earned, nor merely as a piece of work from which renown should accrue to them, but rather as a means of consolidating their political interests, of drawing their two shores closer together, and of assisting in the development and protection of their Pacific States. In brief, it seemed essential to their national position, and under such a spirit it was inevitable that the project should have been taken up with enterprise and resolution.

The Isthmian Commission created by Congress in 1899 was bidden to examine all feasible routes, and to report upon the

site for a canal 'under the control, management, and ownership of the United States.' This was accordingly done. The report submitted was 'that all routes presented greater disadvantages than those of Panama and Nicaragua.' A canal at Panama would be a lock canal, built essentially on the French plans, the report stated, and the cost would be 156,000,000 dollars. A variant of that plan might reduce the cost to 144,000,000 dollars.

As for the Nicaragua route, a canal would begin at Greytown on the Caribbean Sea, with an artificial harbour, follow the valley of the San Juan River for 100 miles to Lake Nicaragua, cross this great lake for 70 miles to the mouth of Las Lajas River, go along the valley of that stream to the divide or water-parting of the continental backbone, and crossing this to the valley of the Rio Grande, following it to Brito on the Pacific, where an artificial harbour would be constructed. From sea to sea this route would be 187 miles long. A dam in the San Juan River would be necessary; and the lake, at 104 or 110 feet above sea-level would be reached by five locks of varying height on the Caribbean side and four locks on the Pacific side. The time required to build such a waterway would be ten years, and the cost 200,500,000 dollars.

The points for and against these two routes were: that the Panama route would be shorter and have fewer locks and less curvature than the Nicaragua route, and a vessel could pass through the first in twelve hours, in contrast with thirty-three hours for the second. On the other hand, the distance between New York and San Francisco was 377 miles less by the Nicaragua route than by the Panama route, giving a slight advantage in point of time on a journey between the two places, and correspondingly with others.

Again, the route of the Panama Canal was covered by an exclusive concession given to the French, and the commission averred that it was not possible to reach any agreement with the New Panama Canal Company. That company did not wish to sell its franchise, but would only sell part of its stock, which arrangement would not suit the ambitions of the United States. On the other hand, the Nicaragua route was untrammelled by any concessions; and therefore, if an acceptable concession could be obtained from Nicaragua and Costa Rica, the report stated that the most practicable route for an isthmian canal under the control, management, and ownership of the United States was the Nicaragua route. The report was an interesting and exhaustive document;

the investigation having occupied two years.

This report, and the evident intention of the United States to act upon it, brought consternation to the New Panama Company in France, and their shares fluctuated greatly. The company had brought its work to a point where it seemed that an appeal might be made to the investing public for capital to carry out the high level scheme. But if the United States were in earnest, no one would be likely to subscribe afresh to a moribund enterprise, or one which was likely to be duplicated by a powerful government backed by a national treasury. In their study of the Panama route the American Commission had made a valuation of the French works and property, which they placed at 40,000,000 dollars.[1]

This sum was considered grossly inadequate by the French owners, who valued their property at somewhat over 109,000,000 dollars. Indeed, the American valuation aroused considerable discussion in the United States, where many held that it was greatly understated and unfair. But deeming it their only wise course, the company in Paris cabled an offer to Washington to sell out at that figure. Consequent upon this turn of affairs, the Commission

[1] The French official receiver had conservatively placed the value at 90,000,000.

issued a supplementary report, reversing its former conclusion, and advising the adoption of the Panama route and the purchase of the property of the French company. A few days before, a bill had been carried in the American House of Representatives by a large majority, authorising the construction of the Nicaragua canal at a cost of 180,000,000 dollars. When it reached the Senate, however, an amendment was moved, the so-called 'Spooner Bill,' authorising the President to acquire the French property at Panama; and this became law in June, 1902.

The sum of 40,000,000 dollars was to be paid in purchase, which was to include not less than 66,869 shares of the Panama Railroad Company. Further a strip of land was to be obtained from Colombia, in perpetual control by the United States, as the Canal Zone. The President was authorised, in the event of these measures not being successful, to enter into a treaty with Nicaragua and Costa Rica for the territory necessary for a Nicaragua canal.

There was, however, during these deliberations, a futher element to be considered; that of the rights of Great Britain, which, as before described, gave that power a well-defined standing in the matter, embodied in the famous Clayton-Bulwer treaty. This treaty was

negotiated in 1850 by John Clayton for the United States, and Sir Henry Lytton Bulwer for Great Britain, and arose out of the situation created at that time by the proposed Nicaragua canal.

This treaty guaranteed the neutralisation of a canal, bound both parties not to obtain or maintain any exclusive control of the proposed canal, or unequal advantage in its use, and established the same principle 'to any other practicable communication, whether by canal or railway, across the isthmus which connects North and South America.' Further, it stipulated that neither party would 'occupy, or fortify, or colonise, or assume or exercise any dominion over Nicaragua, Costa Rica, the Mosquito Coast, or any part of Central America.'

The treaty was signed and ratified in April, 1850, by both Governments, but before the ratifications were exchanged certain declarations on both sides were made, whose interpretation gave rise to some dissension. However, in 1859–60 the questions were settled 'nearly in accord with the American contentions, and this settlement the United States accepted without cavil for many years.'[1] Until 1866 the policy of the United States was consistently for interoceanic canals open

[1] *Encyc. Brit.*, Vol. VI.

equally to all nations, and unequivocally neutralised, and until 1880 no official divergence from this attitude existed. But in 1880–4 a variety of reasons were advanced why the United States might justly repudiate at will the Clayton-Bulwer treaty. The new policy was based on national self interest. The arguments advanced on its behalf were quite indefensible in law and history.'[1]

In 1885, however, the Government of the United States reverted to its traditional policy, and in 1902 obtained full power to build a canal under the Hay-Pauncefote treaty, which replaced the Clayton-Bulwer instrument, and adopted the rule of neutralisation for the waterway. This treaty, involving the abrogation of the Clayton-Bulwer treaty, was successfully concluded, due largely to the tact and good management of Mr John Hay, the American statesman and author—who was a man much respected and liked in Great Britain, together with Lord Pauncefote.

The new treaty was, however, not entirely well received in England, as it was considered that too much was given away of British rights. But the British Government was actuated by a generous policy towards the United States, a policy

[1] *Encyc. Brit.*, Vol. VI.

which it cannot be said has generally been reciprocated by the United States, as concerns Latin-American affairs, towards Great Britain, as the Venezuela incident[1]—with its rude and arrogant presentation by American statesmen—and other matters at various times have rendered plain. There was, moreover, a party in the United States that professed to see no necessity for such a treaty; holding that the Americans might and could ignore British claims in the matter.

Since that period, however, the Americans have advanced considerably in their knowledge and methods of international dealings, and that period when the Press and public could be entertained by 'twisting the lion's tail' has grown far less pronounced. Experience with the methods of some of the Latin-American States, moreover, have brought about a modified attitude of what was to be the methods of the Monroe Doctrine. The American people and statesmen had inevitably to pass through an unfledged period of statesmanship in foreign politics, and the 'imperialism' which was thrust upon them by the Spanish-American war, and the inevitable growing-up of the nation, has

[1] This unfortunate work of President Cleveland almost caused a rupture between the two nations, and has somewhat embittered the thoughts of resident Britishers in South America, of whom there are many, towards Americans.

given them a far wider outlook on the world than the narrow and selfish spirit which earlier obtained, from which that type of policy known as 'shirt-sleeve diplomacy' was an outcome. Nevertheless, the discussion of the matter of Canal dues, as instanced subsequently, appeared to show some recrudescence of the spirit.

The Hay-Pauncefote treaty, amongst its provisions, set forth that 'the Canal shall be free and open to the vessels of commerce and of war of all nations on terms of entire equality, so that there shall be no discrimination against any such nation, or its citizen or subjects, in respect of the conditions or charges of traffic or otherwise.' This provision thus established a status similar to that of the Suez Canal. The Clayton-Bulwer treaty stipulated that no fortification to control the canal should be erected, and whilst this clause does not appear in the Hay-Pauncefote treaty, it is nevertheless laid down therein that 'the canal shall never be blockaded, nor shall any right of war be exercised nor any act of hostility be committed within it.' By reason of its subsequent acts or intentions, as concerns these points, the United States has been accused of breaking both the spirit and the letter of these clauses; as regards fortification, although with extenuating circumstances.

CHAPTER VI

TREATIES AND REVOLUTIONS

THE next step in the building of the Canal, after the agreement of the French company to sell out its rights, was the negotiation of a treaty between the United States and Colombia. In December, 1902, the Government of Colombia sent as its representative to Washington Dr Tomas Herran, who himself was favourable to the American project; and in January of the following year a convention known as the Hay-Herran treaty was signed. Under this, Colombia agreed that the French company should sell its rights and privileges, including the Panama Railroad, to the Government of the United States; that a strip of and across the isthmus for the Canal Zone should be given into the perpetual administrative control of the United States, with a combined system of jurisdiction as regarded the administration of justice. The United States, for their part, agreed in return for these privileges to pay Colombia the sum of

10,000,000 dollars in cash, and 100,000 dollars a year rental, to begin nine years after the ratification of the treaty. This treaty, in March of the same year, 1903, was ratified by the United States Senate, but was thrown out by the Colombian Senate, who refused to ratify it.

The events following on this refusal or repudiation by Colombia were dramatic, and to a certain extent 'operatic.' But by Colombia, and by many independent observers, they have been made the subject of bitter accusations against the United States. On the other hand, apologists of the United States have asserted that no aspersion can be cast upon that country; whilst the exponents of expediency and opportunism have upheld the legitimacy of the circumstances.

The Americans were greatly disturbed by the Colombian action, which they regarded as a 'hold-up game,' or attempt to extort greater benefits when it was seen how anxious the United States were to use the Panama route. The Colombians, for their part, maintained that the provisions were not sufficiently advantageous for them, and that an abandonment of 'sovereignty' incompatible with national dignity was involved. Fiery and eloquent politicians at Bogotá urged that the great national birthright—which the

possession of the Isthmus of Panama was —was being sold for a mess of pottage.

The Americans further were convinced that Colombia purposed delay, so that the term of the concession to the French company might expire, in order that Colombia might directly enjoy the payments arising from the treaty. There had been no regular legislative government in Bogotá for many years, and the Congress which had considered and rejected the treaty had been specially called for the purpose.

The discussion drifted along for several months. There were requests from Colombia for better terms, and warnings from the United States that a difficult international situation might be created. Secretary Hay pointed out to the Colombian representative that the negotiations had been initiated by Colombai, pressed upon the American Government, and agreed to by the United States; and that if Colombia 'should now reject the treaty, or unduly delay its ratification, the friendly understanding between the two countries would be so seriously compromised that action might be taken by Congress next winter which every friend of Colombia would regret.'

These threats, however, were unheeded in Bogotá, and the Congress, which should have

ratified the agreement, rejected it in August, 1903. In September, the Colombian Government privately informed the Washington State Department that, notwithstanding its rejection of the proposal, it was prepared to reopen negotiations. This was regarded in the United States as 'a characteristic piece of Latin-American jugglery.'

The French Canal Company naturally suffered great anxiety during these disputes, fearing that the Nicaragua route would, after all, be that finally adopted. Further, the people of Panama, who had greatly benefited by the expenditure of money on the isthmus, feared that a continuance of these favourable business conditions would be lost to them. The prospect of the United States being driven to the Nicaragua route weighed heavily upon them. As for the Nicaragua route, however, there was no assurance that the Government of that country would not take the opportunity of fishing in troubled waters and create onerous conditions for a concession for a canal in their territory. Nicaragua at the time was under a dictator.

On the 31st of October the Colombian Congress adjourned, and the Hay-Herran treaty was shelved. Then the blow fell. Three days later, on the 3rd of November, the independence of Panama was proclaimed, and

United States warships, collected at both ends of the canal, prohibited the transportation of Colombian troops across the isthmus, and landed marines to prevent the occupation of Colon by Colombian forces. On the 7th of November, Panama was virtually recognised as an independent republic by the United States, when her diplomatic representative was received; and on the 18th a treaty was signed between the United States and the suddenly-created republic, ceding the 'Canal Zone' to the United States, under a promise of immediate payment by that country of 10,000,000 dollars, and 250,000 dollars as annual rental. Two months afterwards, Panama elected a constitutional assembly and president.

The independent observer will find it difficult not to believe that there were some clever American machinations underlying this sudden change; but it cannot be said that this has been absolutely proved. The attitude of the student of American affairs who, whilst striving to be impartial, knows the character both of the Anglo-American and the Latin-American people and the lines and methods upon which they are accustomed to act, must, as regards this incident, necessarily be one of a mental see-saw. The facts of the case to a certain extent are known, but the real

truth underlying the actions and minds of the two parties are not and possibly never will be revealed.

The character of the people of the United States and that of the people of Colombia (or any other Spanish-American community) are similar in one respect—that of exercising what the American terms 'bluff.' Bluff is a characteristic of the American peoples, born of the more primitive morality and lack of moral backbone of a new nation, acting in conjunction with a spirit of progress. The Anglo-American is up in arms in a moment; he presents a fierce and wordy front as his first line of defence, a species of moral beak and claws with which he seeks to overawe. The Latin-American follows the same methods, except that he assumes therewith a cloak of dignity and invokes high altruistic motives, which, if they were really genuine would obviate the necessity for the use of bluff at all. The bluster of the man of the United States may be brutal, but it is not generally hypocritical. When these two kinds of menace are opposed, as they are in inter-American relations at times, the final issue as to giving way is a question of the possession of the 'heaviest battalions.'

In this case, however, North American bluster was also accused of being underhand; and the

most severe critics of the policy and incidents were Americans themselves. The accusation levelled against Colombia that she hoped to profit by shelving the treaty, was denied by the apologists of that country. On the other hand, it was the kind of procedure to be expected of Latin-American countries, which, whilst attributing high or necessary motives to their actions too often are but covering what is in reality something involving double dealing. If this was the case, the Americans were naturally exasperated, and not likely to observe nice points of etiquette. Probably the truth is that Colombia overreached herself. The operation is a common one in South America in commercial transactions; too much is asked, too great a bargain expected. On the other hand, this was scarcely an excuse for the alleged breach of faith of the United States.

The diplomatic excuse of the Americans for preventing the operations of Colombian forces in what was Colombian territory, in order to quell what was a rising by a small handful of citizens, a procedure which would have been impossible when dealing with a stronger nation, was that, by the treaty of 1846–7 the United States had promised to keep the isthmus open for traffic, and that civil war would have closed it. Yet in that

treaty the Americans had undertaken to guarantee the sovereignty of Colombia over the isthmus, and its perfect neutrality.

The apologists of the United States argued that this only referred to outside powers or aggression, and not to inside disturbances or revolution. In this there is something of the same evasive element as appeared in 1912–13 in the American contention with Great Britain about the Canal dues, that the term of equality regarding these, as agreed upon in the Hay-Pauncefote treaty, did not apply to American coasting vessels. Furthermore, this guarantee against outside aggression was a guarantee against such aggression by the United States itself, who nevertheless violated it. The civil wars of Colombia were not necessarily the concern of the United States. Disappointment with the shelving of the Hay-Herran instrument may have been acute, but the convention itself stated that it was to be 'ratified in conformity with the law of the respective countries.' The American Senate ratified it, but not the Colombian.

The Colombians met the charge of underhand intentions regarding the lapse of the French concession by showing that this would not lapse, as it had previously been renewed, they asserted. The principal apologist for the action of the United States

in the matter was the then President Roosevelt, who, indeed, claimed to be the author of the proceedings, as far as the United States was concerned. The ex-President has been gravely arraigned by some of his own countrymen for his part in the affair,[1] but foreign observers either knew little of its workings or were influenced by what has been regarded as the expediency of the matter.

President Roosevelt is quoted as saying, in a public statement, that 'It must be a matter of pride to every honest American, proud of the good name of his country, that the acquisition of the Panama Canal in all its details was as free from scandal as the public acts of George Washington or Abraham Lincoln. . . . The interests of the American people demanded that I should act exactly as I did. . . . Every action taken was not merely proper, but was carried out in accordance with the highest, finest, and nicest standards of public and governmental ethics. . . . We not only did what was technically justifiable, but what we did was demanded by every ethical consideration, national and international. . . . We did harm to no one, save as harm is done to a bandit by a police-

[1] Among them L. T. Chamberlain on 'A Chapter of National Dishonour,' in the *North American Review*, February, 1912.

man who deprives him of his chance for blackmail. . . . The United States has many honourable chapters in its history, but no more honourable chapter than that which tells of the way in which our right to dig the Panama Canal was secured, and of the manner in which the work was carried out.' Elsewhere Mr Roosevelt said,[1] 'I am interested in the Panama Canal because I started it. If I had followed traditional conservative methods I would have submitted a dignified State paper to Congress, and the debate on it would have been going on yet; but I took the Canal Zone, and let Congress debate; and while the debate goes on the Canal does also.'

In regarding the assertive style of these pronouncements the character of their speaker must be taken into consideration. Mr Roosevelt attained world-wide fame for his talents and eloquence, which was not undeserved; but he was to some extent typically a 'Westerner,' as the man of western America is termed in the United States. The spirit of the 'cowboy' and the executive of the revolver still tinges the habits and utterances of the people of the western states, although to a lessening extent. The breezy open-handedness of the President seemed to have been marred by opportunism.

[1] Before the University of California.

It was asserted that the small revolutionary Junta of Panama had intrigued at Washington, hoping to attain the direct co-operation of the United States or at least to sound the authorities as to what would be their feeling in the matter. But 'the replies given by Mr Hay, the then secretary of State, were diplomatically discreet and guarded. He told Dr Amador, the Panama emissary, that however much the United States might sympathise with Panama, and however much it might regret, or even resent, Colombia's rejection of the Canal treaty, it would be manifestly impossible for the Government to give any aid to a revolutionary enterprise, or to commit itself with any promises in advance. It would scrupulously fulfil its duties as a neutral, and would inflexibly maintain its rights and privileges under the treaty of 1846 with New Granada. These included the protection of free neutral transit across the isthmus, and the guarantee of the sovereignty of land against alien aggression, though, of course, it did not guarantee Colombian possession of the isthmus against local and domestic revolution. But the United States could give no promises to, and make no treaties with, a Government which was not yet in existence.'[1]

[1] *Four Centuries of the Panama Canal*, W. F. Johnson, New York.

It is stated that the Panama revolutionary emissary drew his own conclusions from the latter part of this diplomatic address, and left the State Department in a pleased frame of mind; and the revolution immediately followed. It was a bloodless one, and five American warships at Colon, and four at Panama, were present during the somewhat 'Gilbertian' proceedings which took place. The American Government cabled on the following day, 2nd November, to the commander of the ships at Colon :—'Maintain free and uninterrupted transit. If interruption is threatened by armed force, occupy line of railroad. Prevent landing of any armed force with hostile intent, either Government or insurgent, either at Colon, Porto Bello, or other points.' In view of the fact that it was only the Colombian Government that could 'land an armed force,' as the insurgents were the people on the spot, and, moreover, had no navy, there would appear to have been considerable significance in the despatch.

The 450 Colombian soldiers who landed at Colon on the 3rd, before the revolution actually broke out, were refused transport by the railway company. The generals had unwisely gone over to Panama without their army, and they were easily imprisoned. The three Colombian gunboats threatened to

bombard Panama, and in effect some shells were fired, which killed a Chinese cook—the only casualty. The new Republic was acknowledged three days later by the United States. The chief Colombian general—it was asserted—was bribed with a sum of money by the Panama Junta to embark his troops, which he did. The troops, however, learning of the transaction, seized and divided the money. The ismay of the Colombians in Bogatá was sudden and deep. They had expected the United States to abide by the spirit of the old treaty. When they saw the position and recognised that the great opportunity which their topographical possession had given them, their native birthright of the isthmus, was practically gone, they sent a despatch to Washington, promising that they would ratify the Hay-Herran treaty in the next Congress, if the Americans would put down the revolution. But it was too late.

The conclusion of the whole matter appears to be that Colombia opposed obstacles, real or fancied, to the concluding of the treaty with the United States, notwithstanding that she in reality desired the canal to be built; and that the United States, resolved at all hazards to build the canal, and exasperated by their treatment at the hands of Colombia, stooped from a high ideal of international

rectitude to secure that their will should prevail.

It must be remembered that to the American people the Canal did not present itself merely as a business enterprise from which dividends might be earned. Rather it was a medium for consolidating and developing their national interests, by giving them easy access from one side to the other of their great dominions, and so was vital to them. But it has been argued by a more altruistic American sentiment that these ends could have been secured without the doubtful element involved.

It has been asserted by American writers 'that the holders of the stock in the French company had a direct financial interest in bringing about a revolution which would lead to the making of the canal.' The American President, Mr Roosevelt, in answering criticism endeavoured to make the point that there had been 'fifty-three revolutions in Panama in fifty-seven years'; which, however, was qualified as an exaggeration by the apologists of Colombia, although revolutions had occurred in the history of Panama.

It cannot be doubted that Panama had little regard for the Colombian Government, and when the treaty was being discussed in the Colombian Senate threats

had been received at Bogata to the effect that if it were thrown out the isthmus would revolt. The spending of a possible 10,000,000 dollars, for the local merchants and politicians of Panama, was a heavy temptation moreover. Possibly a revolution would have occurred earlier, if the clause in the treaty between Colombia and the United States that 'the United States also guarantee the rights of sovereignty and property which New Granada has and possesses over the said territory' had not been before them.

In fairness, however, to the 'toy' Republic of Panama, it must be said that they considered they were justified, or endeavoured to show themselves justified, in their act. The 'Declaration of Independence' of Panama, in 1903, began in the usual grandiloquent manner of Latin-American documents :—'The transcendental act that by a spontaneous movement the inhabitants of the isthmus have just executed,' it ran, 'is the inevitable consequences of a situation that has become more serious daily. The recapitulation of the grievances suffered by the inhabitants of the isthmus at the hands of their Colombian brethren is a long one—grievances which have been withstood with resignation in the interests of national union and harmony. But we have solemnly to declare that we have the sincere

and profound conviction that all our hopes were futile; all the many sacrifices on our part useless.'

Unfortunately this is the language often employed by a Spanish-American individual or nation when some act of double-dealing is contemplated or excused. Doubtless in Panama's case there was much of truth in the assertion. The declaration also complains of what was to a large extent true, namely, that out of the large sums netted by Colombia in the transactions connected with the isthmus, nothing had been spent, whether in bridges, roads, schools, or public buildings, in Panama. 'Thus the people of the isthmus, in view of such notorious causes, have resolved to recover their sovereignty and to form a part of the brotherhood of free and independent nations, to work out their own destiny and to discharge their duties to mankind which the immense natural wealth of their territory calls upon them to perform.' Effective peace was to be established. which 'consists in the frequent and harmonious play of all interests and activities, and where finally civilisation and progress will find perpetual stability.'

The declaration concluded upon that high note which Latin-American people generally employ and which—theoretically—is often

meant sincerely, but in practice too often reduces itself to a matter of words: 'Just as a son withdraws from the paternal roof, so the Isthmian people, in adopting the destiny they have chosen, do so with grief, but in compliance with the supreme and inevitable duty the country owes to itself. Upon separating from our brethren of Colombia we do it without hatred and without joy.'

This manifesto had been prepared and was brought forward by the Municipal Council of Panama, which had been the active body in the revolution; and it was 'ratified' the same day at a meeting of Panama people, who collected in the plaza of the Cathedral. It appears to have been generally accepted by the people of the isthmus—acquiescent, apathetic, or ignorant.

On 7th November, the incipient republic appointed as its first representative to the United States, M. Bunau-Varilla, the active Frenchman who had been so prominently associated with the canal. This gentleman had given his support and assistance to the movement. On 18th November, a treaty between Panama and the United States, to take over the Canal Zone, known as the Hay-Bunau-Varilla treaty, was signed at Washington—a rapid piece of diplomatic

work! The emissary of the Bogatá Government, sent by Colombia in all haste to Washington, with an offer to revive the Hay-Herran treaty in a manner more favourable for the United States, was General Rafael Reyes, one of the best-known and most respected statesmen that Colombia had produced; but, as already remarked, this mission was futile.

Thus it is seen that the people of Panama made haste to secure for their own enjoyment the power and benefits which should result from the making of the canal. They were not restrained by moral obligations or ties with their parent state of Colombia, and they easily threw aside any scruples, although, of course, there was a protesting party against the revolution in the isthmus.

It is to be recollected that Bogatá, the capital of Colombia, is a city remote from the coast. Swamp, jungle, and broken country separate it from the isthmus. The city lies on a shelf of the high Andes, 8600 feet above sea-level. It is the centre of an advanced South American civilisation, the home of a people of many excellent attributes, and possessing old and valuable traditions of learning and culture, as well as being of considerable natural and architectural beauty. But due partly to its isolation—no railway connects it directly

with the coast—its inhabitants are considerably out of touch with the modern world, and preferred to remain haughtily in their reserve. What they regard as an unspeakable outrage on their sovereign rights has now passed into history, but time has not healed, nor is likely to heal, the scar.

Under the Hay-Bunau-Varilla treaty, between the United States and the Republic of Panama, the Americans guarantee to maintain the independence of the latter, and undertook the payments before described; the annual rental of 250,000 dollars to begin nine years after the cash payment of 10,000,000 dollars. In return for this, the United States obtained practically its own terms; including a zone ten miles wide, with such 'rights, power, and authority as the United States would possess and exercise if it were the sovereign of the territory, to the entire exclusion of the exercise by the Republic of Panama of any such sovereign rights, power, or authority,' with 'further grants to the United States in perpetuity of the use and control of any other lands and waters outside the zone, which may be necessary and convenient for the construction, maintenance, operation, sanitation, and protection of the Canal.'

The United States has been severely criticised,

and by its own people, for the terms of this concession, made with the 'provisional government' of a so-called republic, agents who were the same group of men that had formed the Revolutionary Junta. These agents neither really represented the people of Panama as a whole, nor were in a position to stand out against the demands or clauses of the treaty put forward by their powerful 'protector,' the United States. There was no democratic sanction for the handing over of these vast powers and sovereignty. 'When the National Assembly of Panama came together for the first time it found that the republic it was elected to govern had already been handed over as a practical protectorate to another nation, too strong to be resisted.'[1] To a certain extent Panama was punished; and dislike of the Americans grew to being among a certain class of the Panamanians.

The people of Latin America, as a whole, it cannot be said, regard the American with affection; and in Panama the situation served to accentuate the lack of sympathy. Serious questions have arisen between the small republic and its powerful protector, and the Panamanians deeply resent the attitude which treats their nation as a capricious child. 'Bitter criticism of the Americans appear

[1] *Panama*, Albert Edwards.

frequently in the Panama papers and ridicule is freely indulged in.'[1] Under this treaty with Panama the United States has the right to police the cities of Colon and Panama if it chooses, although these places do not come under the general possession by the American of the Canal Zone. The educated class of the people of Panama stand much aloof from the Americans. Retaining their old Spanish customs and reserve, the Latin-Americans do not understand or sympathise with the American character, with its peculiar brusqueness and lack of ceremony; conditions such as obtain also in Mexico and South America, where the two races are brought into proximity.

A comparison of the Latin-American and Anglo-American people and their characteristics is a subject of considerable interest, which, however, cannot be entered upon here.[2] Both races can learn much from each other. It is easy for the American of the United States, full of energy, in accomplishing material things and in enriching himself, to pretend to despise his Spanish-American neighbours, with the latter's different outlook on life, attention

[1] *The Times.*

[2] The author has gone fully into the subject in his book, *The Republics of Central and South America: Their Resources, Industries, Sociology, and Future.* Dent and Sons, London, 1913.

to the courtesies and amenities of social intercourse, and habit of procrastination and quixotic character. But both peoples have their value in moulding the civilisation of the New World. The civilisation of the future, we shall not believe is to be dominated by money-getting as its principal motive.

If, moreover, there are serious faults in the Latin-American character and social regimen, leading to revolution and waste, no less are the crimes of commercial fraud, of bank and train robberies, of the depredations of trusts, and the personal vendettas of the United States censurable. North American life possesses many menaces to its own civilisation. It is still very far from a true 'Americanism.' But the great gain to Latin America in its contact with Anglo-America is in the methodical work, cleanliness, and sanitation of the latter, in which the meridional people are grievously deficient.

CHAPTER VII

THE CANAL AS IT IS

It is pleasing to leave the history of the canal, the wranglings of lawyers and the deceptions of diplomatists, to take into consideration the actual work of construction. It is a truism to state that the obstacles raised by man to the performance of any great project are in reality more difficult to overcome than those raised by nature. The reflection will occur constantly to the student of humanity and the undeveloped world.

The Americans began the work with their accustomed energy. Enthusiasm was high in the United States. What France had failed to accomplish, the American nation would now perform—so ran the popular cry in the States. But the Americans were yet to experience their own share of difficulties and disappointments. As time went on, the disdain for French methods and what these had accomplished was to give place to a just appreciation, born of hard experience and a chastened frame of mind. To 'make the dirt fly,' in 'the

big ditch' was a popular clamour in the United States, 'dirt' being the popular American equivalent for earth, and 'ditch' for canal. The cry was in part bombastic, and in part indicative of power.

A few days after the ratification of the treaty with Panama, a commission was appointed by President Roosevelt to undertake the organisation and management of the work, composed of seven members, with Rear-Admiral John Walker as chairman, and General Davis as Civil Governor of the Canal Zone.

Here followed the first disillusion of the people of Panama. The leading citizens had arranged an elaborate ceremonial for the proclamation by the Governor that the United States had assumed control of the zone. But General Davis, ignoring this, contented himself with having a simple poster pasted up, baldly announcing the fact. The Panamanians, accustomed to the grandiose methods of the French, were chagrined; they protested to Washington, and the Governor was then instructed to attend the banquets which had been prepared. The manners of the American Governor, 'which had the proverbial military brusqueness, proved offensive to the Panamanians. With the exception of Colonel Gorgas (appointed later), almost all our

official representatives on the isthmus have shown a positive genius for offending the delicate sensibilities of the natives,'[1] says one American writer.

The appointment of chief engineer of the work was given by President Roosevelt to Mr Wallace, an eminent railway engineer, and Mr Magoon was nominated Civil Governor of the second commission, with Mr Shonts as chairman. The work was admittedly difficult. So far the exact type and route of the Canal had not been determined by the Americans; and the general condition of the work, left by the French, was almost unknown.

Everything had to be investigated and planned. A narrow excavation, backed by dense jungle on either side, stretched from Colon to Panama. Examination of the line of the Canal by the engineers revealed, half buried in vegetation, piles of rotting machinery, locomotives with trees growing out of them, houses falling to pieces, stores of all kinds in disorder, and sections of railway tracks terminating in fever-haunted swamps. There were settlements along the line of the Panama Railroad, inhabited in some cases by the most extraordinary types of people—Negroes, Chinamen, and derelicts of numerous

[1] *Panama*, Albert Edwards.

nationalities, and the progeny created by their inter-breeding, often inhabiting shanties built on piles over stagnant fever-haunted pools. The old French canal from Colon to the Gatun Hills had become a stagnant ditch, but of what value it really was none knew. Malaria was everywhere prevalent, the still more terrible menace of yellow fever hung over the zone, and the fearful visitor or traveller, almost loath to leave his steamer, hurried across the isthmus or slept in the hotels at Colon or Panama in dread.[1]

However, by January, 1905, Mr Wallace had 1200 men at work, principally on the Culebra Cut, and two of the French excavating machines and a similar number of American steam shovels, whilst valuable information had been gained. The chief engineer was hampered by official delay and red tape at home, which worked against 'the impatient and undue anxiety of the American people to see the "dirt fly" ' as it was expressed.[2] The red tape was partially due to the desire to avoid any financial scandal, such as had characterised the French regimen. The growth of graft, or misappropriation of funds, is so common a condition in American public

[1] This was the condition of the isthmus when the author first crossed it.

[2] By the *Engineering Magazine* of New York.

works, that this was naturally feared on the Canal Zone, especially at so great a distance from home; and it is greatly to the credit of the Americans on the canal that their hands have been so clean throughout from this national reproach.

Among the matters due to the officialdom was delay in the Panama water supply, the installation of which was very urgent, and the obtaining of mosquito-netting for the windows of the dwelling-houses and offices erected for the Americans in charge. Valuable lives were imperilled through this neglect; and, as a consequence, there was a panic among the employees, due to fever and malaria occurrences, as later described.

This unsatisfactory state of affairs was recognised by President Roosevelt, who brought about a change in the personnel and methods of the Commission. It was required that the members of this body should reside on the isthmus instead of at Washington; and it was decreed that material and labour might, if required, be obtained outside the United States, and under less difficult conditions. As these latter items were against the United States tariff laws and contract labour law, Congress refused to sanction them, but they were carried out by Mr Roosevelt in characteristic fashion. The

chief engineer, Mr Wallace, however, resigned. He was replaced by Mr Stevens, another well-known railway man.

As a consequence of the difficulties and dissensions attending the work, it was found advisable to appoint a board of consulting engineers, of an international character, to consider the positive plan to be followed. Five of these engineers were Europeans, including the chief engineers of the Kiel and the Manchester Ship canals, the directors of the Suez Canal, and the state waterways of Holland, and of the French *Ponts et Chaussés*; with eight eminent American engineers.

The question to be decided by these thirteen gentlemen was: Should the canal be a sea-level or lock canal? Majority and minority reports were given in. The first was signed by eight of the consultants, including all the Europeans, and was in favour of a sea-level canal. The minority report, by five American engineers, was for a lock canal. Both reports agreed that the sea-level type would probably cost double, both in money and time, that of the lock type; but the majority report held that the advantages of their plan warranted the outlay. The canal engineer, Mr Stevens, voted for the lock canal. The arguments for the lock canal were that it would be as safe and useful as the other type, that it would

provide the best solution of the problem of the Chagres River flood waters, that its enlargement, if necessary, would involve much less expense, that the cost of operation and maintenance would be less, and the time and cost of construction only half that of the sea-level canal.

The reports were considered by the regular Isthmian Canal Commission, who, with the exception of one member, endorsed the lock type. They were then considered by President Roosevelt and Mr Taft, Secretary of War, both of whom supported the lock type, and the subject was referred to Congress in February, 1906. It was argued that to attempt to make a 'Straits of Panama' was in any case impossible; that any type of waterway would be a canal. Congress voted in June for a canal with locks, and this decision settled, once for all, the question of the type. Subsequent events, especially as regards the excavation, have shown that this was a wise decision, notwithstanding that it was taken in the face of the most expert European engineering advice.

According to the plan finally adopted, and on which, with minor alterations, the canal has been built, the total length from the Atlantic to the Pacific terminus in deep water is fifty miles. In Limon Bay, on

the Atlantic side, this includes four-and-a-half miles of dredging from deep water to the shore line, and in Panama Bay five miles, leaving forty-and-a-half miles from shore to shore. Three miles from the Atlantic shore-line lies Gatun with its great dam and three locks. This dam, holding back the waters of the Chagres River, forms a huge lake, with its surface between eighty-two and eighty-seven feet above sea-level. Across this artificial lake the canal way lies, a series of tangents and curves, and, entering between the banks at the head of the lake to Obispo, proceeds upon the same level for 31½ miles through the Culebra Cut to the dam and lock at Pedro Miguel.

Passing this single lock, the waterway follows the valley of the Rio Grande, which has been converted into a smaller artificial lake—Lake Miraflores—with an elevation of 55 feet above sea-level, for two miles to the Miraflores locks, two in number; where it proceeds for some 3½ miles to the Pacific coast line.

The channel leading from deep water in the Atlantic or Colon Bay side, to Gatun, about 7 miles long, is 500 feet broad, widening to 1000 feet from a point north of the locks, in order to form a basin for waiting ships. From Gatun locks, which are 0·6 miles

in length, the channel is about 1000 feet in width for a distance of 16 miles to San Pablo. Thence it narrows first to 800 feet, and again to 700 feet, for 3½ miles to Juan Grande, and to 500 feet for 4½ miles from Juan Grande to Obispo (at mile 31¼).

From this point the Canal, through the Culebra Cut to the Pedro Miguel lock, is 300 feet wide at the bottom, widening to 500 feet in the Miraflores Lake, 1¾ miles long, to Miraflores locks, whose length, including the approaches, is one mile. This width will be maintained to the terminus of the Canal in the Pacific, about 8 miles. The average bottom width of the Canal is 640 feet, with a minimum for the narrower portions of 300 feet. The minimum depth is 41 feet. Most of the curves have a radius of 3000 metres, or 9842 feet; the sharpest, however, that near Bas Obispo, on the Atlantic side of the Culebra Cut, having 5577 feet, or 1700 metres radius.

The dam closing the great artificial Lake Gatun is 7700 feet long, upon its crest, including the spillway or overflow for the surplus waters. It greatest thickness at the base is 2060 feet, or nearly half a mile, and 400 feet at the level of the surface of the water. Its height, of course, decreases from the centre to the sides, in accordance with the

slopes of the valley, and only for about 500 feet does it have to resist the maximum head or pressure of the water. The dam is built of earth, with a central core, or longitudinal wall running through it, from end to end.

This dam is the only questionable feature of the high-level canal. It is not of masonry built upon solid rock, but of earth placed upon earth. A stone dam—such as that proposed at Gamboa in the project of a tide-level canal—would have been founded upon solid rock, but this was not possible in the present system. However, earthen dams have stood for centuries in many parts of the world. The greatest danger to which they are exposed is that of leakage or undermining, between the original surface of the ground and the material of the dam. Such leakage, if it occurred, or were not immediately controlled, would lead to the rapid destruction of such a structure. If, however, an earthen dam can be made of such stability and texture that it may be regarded as part of the very formation of the hills, it may be even more stable, by reason of its enormous mass, than a masonry dam, which is but a thickened wall in effect.

In dealing with a great canal or reservoir, or other hydraulic work, the problems and risks are more considerable than in other kinds

of engineering work, such as the construction of a railway or road. Water is a wayward and capricious element. Its action is often insidious and unexpected, and matter apparently stable and permanent gives way to its slow and noiseless but ceaseless power. That the drop hollows out the stone has passed into a universal proverb. Any one who has observed the action of a stream upon the foundations or abutments of small bridges, weirs, or sluiceways, or any structure in contact with running water, will have marked how these are at times undermined. The costliest and most solid dam or bridge may be rendered useless by the insidious undermining of a river. A dam, moreover, is a structure called upon to contain a great pressure from the water, and a great overturning force from the same agency.

These forces, it is well to explain for those unacquainted with hydrostatics, are in direct relation with the depth of the water held up by the dam, and have nothing to do with the size of the reservoir behind it. There is no more pressure upon a dam retaining a body of water 10 miles wide than upon one 10 feet or 10 inches wide. It is the height of the dam to the water level that determines the force which has to be resisted, and not the volume of the water.

The Gatun Lake water-level being (an average of) 85 feet above sea-level, and the bottom of the lake at this point 5 feet above, gives a pressure of 80 feet of water upon the dam. The crest of the dam was first designed to rise 50 feet above the surface of the lake, the purpose of this added height being to provide extra weight for the structure, increasing thus its stability, and also consolidating the material of which it is composed. This, however, has been modified to some extent.

The enormous width at the bottom is due to the slope necessary in an earthen bank. This slope on the water side of the dam is one to five; that is, one vertical to five horizontal; the other side is naturally less. The weight per foot of the dam is calculated as being more than ten times the overturning pressure of the water—which is horizontal—so that the whole mass could not move. Due also to the width, this vast weight is spread over so large an area that the ground underneath cannot, it is stated, sink beneath it—another factor necessary to be considered in all large structures.

To prevent seepage or leaking, which, as before observed, is a possibility of earthen dams, a central, impervious core, or wall, has been built. The ground under an earthen

dam has necessarily to be excavated for a considerable distance in order to reach firm soil. At Gatun an indurated clay lies beneath the surface soil, and upon this the dam stands, and it is expected that this will prove sufficiently waterproof. However, the core-wall, embedded in the dam, goes down beneath this, occupying a trench dug below the foundation of the dam for that purpose. The bottom of this trench reaches 40 feet below sea-level. This core consists of a wall of hard puddled clay.

Further, to secure against leakage, even below this core, sheet piling, made of 4-inch timbers, was driven down for another 40 feet, and thus the core and piling together form a barrier intended to be impervious, down to 85 feet below the natural surface of the ground. This puddled core rises through the dam to 5 feet above the level of the lake water. At its eastern end the dam abuts upon a rocky hill of hard, argillaceous sandstone, and in this the locks have been excavated and built.

Midway across the valley in which the dam is situated, is a low hill, not, however, of rock, but of alluvial material, and this is of value as giving some support to the spillway, or regulating channel. The spillway is a structure of solid concrete,

with piers standing thereon, 8 feet thick, between which are the sluice gates. These sluice gates serve to maintain the surface of Lake Gatun at the desired level in flood times, and the surplus waters of the river pass over the spillway. The bottom of the Gatun valley was traversed by two old river gorges, which contained gravel, sand, shells, wood, clay, etc., to a depth of 200 and 260 feet, and of about 1200 feet and 500 feet respectively in width. These old river channels are below sea-level, due to some ancient sinking of the land. They were defective points as regarded the matter of leakage, and must always remain sources of some anxiety in the stability of the dam. However, it is seen that all measures possible for the security of the dam were undertaken.

The great Lake Gatun may, from one point of view, be regarded as an element of safety, rather than danger. Due to its broad surface and great volume, the torrential Chagres and other streams whose valleys it occupies will be effectually tamed. Lake Gatun is about twice the size of Lago Maggiore, about four-fifths that of the Lake of Geneva,[1] and occupies an area of about 164 square miles. The waters are pounded far back among the jungle and ravines of the isthmus, submerging

[1] Dr Cornish, *The Panama Canal and its Makers.*

trees, streams, rocks, and even villages, and the line of the Panama Railroad was naturally obliged to take a new course around its shores, or across shallow portions, by means of embankments. The verdant forest over this considerable area disappears.

In October, 1912, the first steamboat or launch voyage on the lake was undertaken by the engineers engaged upon lighthouse construction upon the shores. At that date the water in the lake had been allowed to reach a depth of 50 feet, the great dam being near completion, and all the work between Gatun and the Culebra Cut being then finished. The trees on either side of the waterway not having been cut but being partly submerged, present the appearance of a great morass. This, from an aesthetic point of view, is to be deplored, because what might have been a beautiful stretch of water is disfigured by the white skeletons of trees standing up in various stages of decay. The timber of commercial value has been cut, and doubtless the remainder will perish and fall, but it must be some time before this takes place. Along the lake from Gatun some twenty or more islands rise above the surface, and the broad arms of the lake stretch up what were the Gatun and Trinidad valleys, and other ravines in the now dying jungle.

CHAPTER VIII

THE WORK OF EXCAVATION

THE great excavation of the Culebra Cut has frequently been described, and is considered to be the greatest piece of artificial earthwork in the world. It is this part of the waterway alone which is really a 'canal.'

The total amount of excavation, including dredging, for the Panama Canal as originally planned for a lock canal was estimated at nearly 104,000,000 cubic yards of material, apart from the excavation done by the French. Subsequent changes in the plan increased this to about 174,000,000 cubic yards. The total amount taken out by the French was 81,500,000 cubic yards approximately, including the dredging work at both ends and the work in the Culebra Cut, which latter was 22,600,000 cubic yards.

By the end of June, 1908, the Americans had excavated a further 20,000,000 cubic yards in the Cut, by which name is meant the portion of the Canal, 9½ miles long, between Bas Obispo and Pedro Miguel.

The total amount necessary to be excavated in the Cut, as calculated at that period, was about 80,000,000 cubic yards of material for the high-level canal. The total amount of excavation for the prism of a sea-level canal was calculated by the Board of Consulting Engineers at 231,026,477 cubic yards.

In April, 1910, the excavation had reached 103,000,000 cubic yards, equal to almost the amount originally called for in the high-level system. Of the amount which had been excavated by the French, 30,000,000 cubic yards represented work useful under that plan; the remainder being below a necessary level at the end of the canal, within the high-level portion.

The work of excavation in the Cut was almost spectacular in character, in some respects. Delay at first, under the Americans, was occasioned by the popular demand in the United States to expedite the removal of the 'dirt,' before proper organisation and investigation had been carried out. Under the autocratic administration, however, this foolish clamour was unheeded; the 'lobbying' at Washington came to an end, and the appliances were organised for scientific attack of the earthwork.

The equipment embraced more than 100 steam shovels, of the Bucyrus type, machines

of enormous capacity. These consist essentially of a powerful engine on rails, actuating a great steel boom, within which works a second boom carrying a large steel scoop or bucket at its end, both booms being raised, lowered, or impulsed by chains and gearing. Both soft material and hard rock, after loosening by blasting, were dug out, swung round and discharged into the trains of flat cars, and these, when loaded, were hauled away and discharged in rapid succession.

More than 4000 such wagons or cars were employed, and 160 locomotives of American type and 120 of the French type. There were 30 unloaders, of the type well known to railway builders. This apparatus consists of a species of plough drawn by a cable, actuated from a drum on the locomotive, along the top of the train of flat cars—which have flaps to let down, so forming what is practically a long platform. The apparatus throws the material off at the sides, and a whole train of cars is unloaded in the space of a few minutes. A train of 16 car loads of rock and earth, containing over 320 cubic yards, is unloaded by the Lidgerwood unloader in this way in seven minutes.

A large number of mechanical spreaders were employed, and track-shifters—machines

which take up and relay whole sections of railway track intact—were employed, having been made in the workshops on the spot. The great steam shovels represented the latest effort of engineering in the manipulation of earth work; and their remarkable powers, under the skilful handling of the American mechanics in charge, excited admiration on the part of visitors, and gave full satisfaction to the canal engineers and administration. The almost human 'intelligence' of these machines excited general notice. One such shovel can load 1200 cubic yards of material on the cars within an eight-hour day.

The numerous parallel lines of track along the bottom of the Cut gave this the aspect of a great terminal railway yard, to which the constantly departing and arriving earth trains added. The material hauled out of the Cut was discharged in other parts of the isthmus adjacent to the line of the Canal, the greater part being employed in making the Gatun dam; new ground in the swamp at Balboa at the Pacific terminus; breakwaters; and embankments across Lake Gatun for the new railway line. The steam of the engines and the smoke from blasting operations, alternately hung over this great artificial chasm in the hill, and the screeching of the locomotives and the rock drills gave

place to the roar of the great dynamite charges.

Very large quantities of dynamite were used in the blasting operations. The shots were fired twice a day, at noon and in the evening. Electric firing of the explosive was employed. Dynamite was used at the rate of more than 1,000,000 charges a year in 1908; and in 1911 it is stated that 10,000,000 pounds of dynamite were used.

The making of the Cut involved, more than all, the problem of rapid handling and transportation of the material, which was the deciding factor. The blasting and handling of material by steam shovels offered no particular difficulty, but in order that the lowest possible unit price per yard of material extracted should be reached, it was necessary that every facility should be afforded for the rapid discharge of the spoil-trains or 'dirt' trains. These followed each other at intervals of three minutes, and if they were delayed the steam shovels remained idle, which would cause the unit cost of excavation to rise. This occurred constantly at first, but after better organisation, each loaded train was instantly removed, and replaced by empties, due to efficient shunting and relays. Thus the steam shovels were kept working up to their maximum powers,

with consequent economy of operation. The shunters and switchmen were West Indian negroes, who took much pride in their work.

In estimating the amount of excavation required in the canal, both the French and the American and other engineers neglected one factor; which, indeed, it was difficult or perhaps impossible to foresee. This was the matter of landslides. The slides of earth, but especially of rock, and principally in the Culebra Cut, have added enormously to the work. The slides have necessitated constant change of form in the cross-section of the Cut, and have taken back the upper edges far beyond their originally projected lines.

As at first designed the banks of the Cut were comparatively steep, consisting in a series of narrow terraces or bermes, alternating with short steep slopes, as it was assumed that the rock would stand at a very steep angle. This belief has been utterly disproved. The International Board of Consulting Engineers held unanimously that the rock would be stable at a slope of three vertical upon two horizontal. They considered that this slope could be maintained even in the event of a sea-level canal. It is noteworthy that so eminent a body of engineers, European and American, embodying the most expert talent in the world, estimated the strength of the rock to

be such that it would stand at the above slope to a depth of 245 feet on the centre line, such as a sea-level canal would have required. In practice the rock began to collapse from that slope at about 65 feet depth.

Numerous borings had been made, and samples of the rock brought up before excavating, so that its quality was not unknown. But the explanation of the mistake seems to lie in the fact that some of the underlying rocks contained clay, and, above all, iron pyrites. These latter on exposure to air and damp rapidly become oxidised—a process which is well known to mining engineers and geologists—assisting in the disintegration of the rock. Even the hardest quartz may be split up by such action, which is both chemical and mechanical. Thus, when the upper material had been removed, the rain penetrated to the lower rocks and the seams of lignite, clay, and pyritous material, and caused rapid deterioration. It has been pointed out that this action was foreshadowed in the report of one of the French engineers of the International Board, who discovered the friability while preparing specimens of rock from the borings for microscopic examination, and who was obliged to use oil instead of water in preparing these.

The scheme of the Cut as recommended by

the Board, nevertheless, was that the prism of 200 feet bottom width should have slopes of ten vertical to one horizontal to an elevation of ten feet above mean tide, at which elevation there was to be a horizontal berme 50 feet wide on each side. Thence were to be alternating bermes with benches or slopes each 30 feet high, with a slope of four vertical to one horizontal, the width of the bench at the top being 12½ feet.

The soft material overlying the rock was to have a slope of one vertical on two horizontal. It was shown in the report that surfaces fully as steep had stood well since 1889, or for sixteen years, without sensible deterioration. In fact, experience had seemed to show that the steeper the faces could be—apart from the element of crushing—the less they would be likely to deteriorate from rainfall and climate. The most positive statements were made subsequently by American and other engineers as to the undoubted stability of the banks, which, however, were entirely disproved.

The first serious slide was in 1907 at Cucaracha, a little south of the summit of Gold Hill. There the strata seemed to have been tilted from the horizontal by the upward intrusion of the eruptive rocks forming Gold Hill. The opening crack of this slide

was first noted in 1907, in the wet seaso On 4th October, 1907, without warning, this mass of material 'shot almost completely across the Canal, overwhelming two steam shovels in its course, covering all the railway track, and for ten days maintained a glacier-like movement.' The rate of advance of the mass at first was 14 feet in 24 hours, which decreased to 4 feet per 24 hours after a month. The muddy landslide blocked up the whole Cut, with 500,000 cubic yards of material, 30 feet high in places. It consisted mainly of clay, the overburden of the rock, and it was too soft to be excavated by the steam shovels, or to support the weight of these machines. This great slide seriously discouraged the engineers and canal workers generally, and fears were even entertained that the Canal could not be built. But the material was removed by the process of, first, sluicing a passage by means of water brought from a high level, and then hauling it away by trains.

After this obstacle had been overcome, serious and disquieting movements of the rock in other parts of the Cut took place. The most singular feature was the sudden upheaving of the ground in the bottom of the Cut, at the middle, and a sinking in other parts of the same section. This was due to the pressure or weight of the rock, which

tended to 'flow' after the manner of earth, instead of having the characteristic behaviour of rock. The movement was stopped by removing the material on the upper levels of the banks, which reduced the pressure. These peculiar slides took place principally between the points known as Empire and Gold Hill, on the east and west banks, the worst portion being about three miles long.

Until the middle of 1908, the Americans had only lowered the level of the Cut on the centre line 10 feet below the French work, which had brought the bottom to 160 feet above sea-level, with 45 feet of work. The Americans had been occupied in widening the Cut, rather than deepening it. At that time an order came from the United States President to make the bottom width of the canal at this point 300 feet, instead of the 200 feet first decided upon. For the following year no landslides were experienced, but directly deepening was performed, upheavings and landslides developed alarmingly. The terraced slope had been converted into a continuous slope.

In 1910 huge slices of the upper bank foundered, and in several places below them the bottom of the Cut had bulged up as much as 20 feet, and in one case 30 feet.[1] The

[1] The subject has been scientifically studied and expounded by Dr Vaughan Cornish, *Geographical Journal*, March, 1913, and *Contemporary Review*.

subsidences had a concave surface, the upheavals a convex surface. At one of these 'breaks' as they were termed, the first sign of movement was the rising of a steam shovel that was working in the Cut. The machine rose about 9 feet in an afternoon. These movements were in the nature of 'gravitational waves.' In another instance a shovel rose 11 feet. Elsewhere the upheaval, after being removed by steam shovels, appeared again immediately afterwards. The material was removed, but the upheaval appeared again and again, seven times, growing less in size.

On account of these numerous slides and breaks, an increase in the amount of excavation, up to June, 1911, of 10,700,000 cubic yards of material was necessary. To ensure greater stability or better distribution of the weight, the banks of the Cut at these points were again terraced, and a reduction was made in the size of the dynamite charges. In August, 1912, another serious slide occurred, making the twentieth slide, and the total amount of material excavated on account of these movements reached 20,000,000 cubic yards.

The flatter slopes of the valley, rendered necessary by these excavations, greatly increased the width of the Cut at the top—

from 840 feet to about 2000 feet. Further, as the centre axis of the Cut followed the trough of a natural valley, this widening caused the edge to retire higher and higher up the slopes, so that the height, at Culebra, given originally on the plan as 250 feet above sea-level rose to 315 feet, giving a depth of excavation of 260 feet. Had it been necessary to endeavour to excavate the Cut to sea-level, involving a further 85 feet, it is considered that irremediable landslides might have occurred.

A resident geologist was at one period appointed to assist the engineers in charge, but even he had not been able to give warning of the breaks. The slides were in some instances 'dry,' and in others 'wet,' the latter due partly to the action of rain as described. In one case so much of the pyrites were encountered that rapid oxidisation due to the moisture took place, and gave off such clouds of steam that the workmen thought they had encountered a volcano. The cable flashed the news abroad, and in the press of the United States and Europe it was announced that a 'volcano had burst out in the Canal.'

In 1913, the Cucaracha slide became active again, bringing down some 2,500,000 cubic yards of material into the Cut, blocking all the railway tracks and causing the total amount

of excavation at that point, due to slides only, to reach 6,000,000 cubic yards.

The total amount of excavation for the Culebra Cut after the alteration from 200 feet bottom width to 300 feet, and including slides, rose to 100,000,000 cubic yards of material. A revised estimate of the Canal Commission in 1908 had placed the excavation for the Cut at 78,000,000 cubic yards, which rose in 1910 to 84,000,000; in 1911 to 94,000,000; and in 1913 to 100,000,000. This great increase was due as to 13,000,000 cubic yards for the widening, but the greater part was the result of the slides.

It is thus seen there were two classes of slides; one due to percolating water, the other to unstable geological rock formation. In the latter case the steepness and height of the slopes and the effects of blasting, and the removal of lateral support as the material was cut away in the deep parts of the bank, caused the crushing of the underlying rock of poor quality, which was unable to sustain the load, and thus was forced upwards through the bottom of the Cut. This type of slide occurred in the dry season, and was not due to saturation, and was, moreover, completely unforeseen. There was no remedy beyond that of simply hauling away the material as it fell or appeared. The slides have

not delayed the work, as the time was partly determined by the construction of the locks.

What will be the future effect of slides in the Cut remains to be seen. The full stress in rock in such positions develops slowly, and movements may take place for several years to come. The admission of water into the canal adds a counterbalancing weight to a certain extent to the weight of the material, but, on the other hand, the water may tend to further disintegration and chemical action, so neutralising the benefit. In any case it is considered that new slides can be more easily dredged from a full canal than excavated dry. The growth of vegetation on the banks will, moreover, act as some protection. Possibly a concrete covering will be necessary in places. The whole subject is one of much interest and value to the engineers for future undertakings.

The work of excavation proceeded steadily. On October 10, 1913, the Gamboa dyke, a barrier of earth which was permitted to remain in order to prevent the waters of the Gatun Lake from flooding the Culebra Cut during its construction, was breached. This was accomplished in a spectacular manner. President Wilson, in the White House at Washington, fired the 40 tons of dynamite which had been prepared in the barrier.

The course of transmission of the electric spark from Washington, was through Texas, Mexico, Tehuantepec, Nicaragua, and Panama, more than 4000 miles.

The thousands of persons assembled at the scene of the explosion, including Colonel Goethals and M. Bunan-Varilla, saw a billow of black smoke ascend, and when the debris had settled down, small rivers of water were seen making their way into the Culebra Cut, gradually increasing to a large volume. Thus were the waters of the Atlantic and the Pacific slopes first mingled (except that the Cucuracha slide interposed), a few days after the four hundredth anniversary of the beholding of Balboa of the Great South Sea. There remained the disposal of the great Cucuracha landslide, by the aid of the current and the dredgers. This was rapidly breached, and on November 20 a small steamer passed entirely across the Isthmus. The vessel to accomplish this historic voyage was the little French steamboat *Louise*, which had been sent to Panama twenty-five years before, and had conveyed Lesseps to the spot where the first sod was turned. Thus a friendly attention was paid by America to France in choosing the *Louise* for the first passage across the Isthmus.

CHAPTER IX

THE LOCKS AND THEIR OPERATION

THE picturesque simile has been drawn, as regards the Culebra Cut and the Gatun dam, 'of removing a mountain and casting it into the sea; not, however, by faith, but by the work of the colossal steam shovels.' This earth and rock from Culebra had to be transported for nearly 30 miles to form the Gatun dam, from near the Pacific side of the isthmus almost to the Atlantic side. The great dam contains nearly 21,000,000 cubic yards of material. Its construction, which at one time was the subject of grave questioning, is such that, as claimed by an American writer, 'it is not only as enduring as the everlasting hills, but it is more scientifically constructed than they are, and more pains have been taken in its making than in theirs, if it may so be said without irreverence.'[1] It is to be hoped that the verdict will ever remain unchanged.

[1] The Secretary of the Isthmian Canal Commission, Mr J. B. Bishop.

The dam, as finished, does not present to the untrained eye evidence of the enormous amount of work expended upon it. It is rapidly being covered with a tropical growth of vegetation, and this, as it is to a certain extent protective, is permitted. Furthermore, the great structure lies so unobtrusively in its surroundings, as if it were a natural part, almost, of the landscape, that its very appearance seems to give a sense of security. In the course of a few years, according to the American writer before quoted, the future visitor to the Canal, untrained in engineering matters, may be expected to inquire which is the dam. Considerable uneasiness was experienced in the United States during the construction of the work, due to the imaginative reports of newspaper men, who sent abroad the statement that 'the dam was sinking into an underground lake,' owing to some slight displacement of the edge of the bank.

At the Pacific side of the Canal the removing of the material in certain sections was performed by hydraulic excavation. This consists in washing down the bank with great jets of water under pressure, such as is used in hydraulic gold mining—which breaks down the soil and stones with great rapidity. The material flows into the pool or sump below the

bank and thence is forced through steel pipes of huge diameter by centrifugal dredging pumps, and is conveyed by this method for considerable distances to the place where it is desired to deposit the material. This method of excavating by water is efficient and economical in certain cases. The material is used to form dams, and these built up under the process of deposit by water are of extreme solidity.

Perhaps the most important features of the Canal from the engineers' point of view are the locks and their appurtenances. There are twelve locks in all; a double flight of three at the Atlantic side, and double flights of two and one at the Pacific side. The spectacle presented by these enormous concrete structures was more imposing whilst the Canal was still under construction than when filled with water, part of their height being naturally lost to the view. Nevertheless, at Gatun, the approaching steamer will be confronted by a massive wall of concrete masonry 85 feet in height.

Each lock consists essentially of a vast chamber, 1000 feet long and 110 wide, with walls and floor of concrete, and having watertight steel gates at each end. The side walls are from 45 to 50 feet thick at the floor level, perpendicular on the lock face, narrowing

on the land side to 8 feet at the top. The central wall between the parallel flights is 60 feet thick, 81 feet high, with vertical faces. At a point 42 feet above the surface of the floor runs a tunnel longitudinally through this great wall, divided into three stories, the lowest of which is for drainage, the middle for the wires operating the gate and valve machinery, within the wall, and the upper serving as a passage-way for the operators. The locks themselvet will be filled and emptied by means of a number of lateral culverts, discharging upwards in the floors, which connect with main culverts, 18 feet in diameter, running through the walls. The water will both enter and flow out of the locks by gravity.

The whole length of the locks will not necessarily be used for the passage of vessels of smaller size than the full capacity of the locks. The steamers of commerce and of war, navigating the oceans of the world are, to the extent of 95 per cent, under 600 feet long. For the purpose, therefore, of locking smaller vessels through, in order to save both time and water, intermediate gates are to be used in the lock chambers, dividing these into locks of 600 and 400 feet long respectively. The locks were designed to pass the largest ship afloat. The *Mauretania* is 790 feet long, and 88 feet in the beam. The ill-fated *Titanic* was

longer, and the size of trans-Atlantic steamships has tended to increase since. The locks of the Kiel Canal have an available length of 492 feet. The locks are of course in duplicate, so that ships will pass each other on the flight in opposite directions.

The maximum lift of the Panama Canal locks is 32 feet, which is 4 feet more than any existing lock. The width of the lock, 110 feet, is much greater than that of any existing lock, and the gates will therefore be far larger than any now in use. The gates are vast double-swinging doors known as mitre gates. The total number of lock gates, that is, of leaves, is 92, for the whole Canal. These gates are steel structures of immense strength, 7 feet thick, 65 feet long, and from 47 to 82 feet high; weighing from 300 to 600 tons each. Although presenting the appearance of solid gates, they are in reality hollow. With the object of taking the enormous weight off the top hinge and bottom pivot supporting the gates, they are made with watertight and airtight compartments, and thus, since they tend to float, the weight is diminished.

The whole aspect of the massive towering walls with their colossal equipment of ponderous steel gates is very imposing, and photographs of the structure do not give an adequate conception of their size and solidity.

The construction and site of the Gatun locks was earlier assailed by considerable criticism, in that a part of the foundation rested upon material other than rock. In July, 1913, reports reached the Press that some of the great walls of the Miraflores locks had cracked, involving considerable expense. But it is asserted that the foundation of all these structures are entirely secure. More than 2,000,000 cubic yards of concrete were employed in the Gatun locks, and a total amount for all locks of 4,500,000 cubic yards. The floors are of reinforced concrete.

The greatest care will be taken in operating the Canal locks. The ocean steamer arriving at either end of the Canal will be given over to the absolute control, as regards its navigation, of the resident Canal authorities, one of whose representatives will take charge on the vessel's bridge, and another in the engine-room. Great hawsers will then be placed to connect the vessel with the towing locomotives, which run on rails alongside the locks. These locomotives are known as 'electric mules'; there are two on either side of the ship at the bow and at the stern; they run with a centre rack rail, and are equipped with a slip drum which will permit the taking in or paying out of the towing line without actual motion of the locomotive on the track, when desired.

In passing from the elevation of one lock to that of another, these locomotives climb or descend short, sharp gradients, at an angle of about 22°.

Various precautions are taken against over-running. Prior to a ship entering the lock a fender chain stretched across the entrance is encountered. This chain is dropped into its groove at the bottom of the channel if all is clear, but if the ship is moving too rapidly, the great chain will remain stretched, and the vessel will run against it. The chain, being operated at its ends by hydraulic machinery in the walls, will pay out slowly, and so bring the vessel to a stop. These chains, the largest ever made, weigh more than 24,000 pounds each, and each is capable of stopping a ship of 10,000 tons, going at 4 miles an hour, in a distance of 73 feet, which distance is less than that between the chain and the first lock gate. It will readily be understood that almost the only danger that could befall the ship and the locks, is in a ship running at too high a speed into the locks, and ramming the gates; and these chains are one of the safeguards against accident. In the event of the breaking of a chain and the ramming of a gate, there is still a second gate to stop the vessel's course.

In locking a ship through the Gatun locks,

four fender chains will have to be operated; six pairs of gates opened and shut; and eight pairs of valve-gates and thirty cylindrical valves opened, admitting water through the culverts to float the ship upwards. A total number of 98 motors will be set in motion twice during each lockage of a single ship, and this may be increased to 143, according to circumstances. The time required to pass a vessel through the locks is estimated at one-and-a-half hours at each end; with a total for the whole Canal of ten to twelve hours, depending upon the size and speed of each vessel. The system of operating the locks is made interlocking, in order to avoid risk attaching to the personal factor, and the individual parts of the installation, being controlled in various phases, are designed to give the maximum of safety. Thus, a separate motor operates each gate, valve, and fender chain.

In a building above the locks is situated a control-board, sixty-four feet long, with a complete model of the locks and their appurtenances, in which the water will actually rise and fall, and the gates and chains operate in miniature; so that its operator will observe, direct, and control the passage from this conning tower. A special machine was invented on the spot for opening and closing

the gates, and having been put to the extreme test of operating them without water in the canal, has worked successfully. The heavy doors, weighing from 400 to 700 tons each, open and close as steadily as an ordinary door, each movement occupying only two minutes.

In addition to the safeguards against accidental ramming of the gates, above described, there is a further device, known as an emergency dam; a structure in the form of a steel truss bridge of cantilever type. This structure is so disposed that it can be swung across the entrance to the lock in two minutes, and in the event of destruction of a gate and the rushing out of the water to flood the lower locks—an event which might be disastrous—this emergency dam can be lowered to stop the flow; the stoppage being made plate by plate gradually, until the whole outlet is covered. In brief, every precaution that ingenuity can bring to bear is employed against accident in these locks.

The spillway to the Gatun Dam is in the form of an arc of a circle, 1200 feet long and 85 feet wide, cut, as before described, through the centre of the hill of rock in the middle of the dam, with the convex side towards the lake. This heavy concrete structure comprises some 140,000 cubic yards of material. It rises to a height of 69 feet above sea-level,

thus reaching to 16 feet below the 85-feet level of the lake. The 13 concrete piers reach, at their crest, 115·5 feet above sea-level, and the great steel sluice gates between them, regulating the level of the lake, are raised and lowered by machines, and slide on trains of rollers in niches. The discharge capacity of the spillway has been, of course, calculated as greater than the known maximum discharge of the Chagres River in flood times.

It is estimated that passage of the Gatun locks by vessels will be made in fifty minutes. The approach from the Atlantic side is in smooth water. Colon is subject to heavy northern gales or 'nortes,' but shelter is obtained from the banks of the Canal, and from the breakwaters, and no difficulty of entrance is apprehended. On the lake, waves and movement by the breeze is to be expected, but this is not likely to cause difficulty in the entrance to the lock from that side. The vessel proceeds under her own steam through the waterway across Lake Gatun, at a moderate rate of speed, but slows down to four or five miles an hour to traverse the nine miles of the Culebra Cut, occupying two hours.

At Pedro Miguel the one lock and at Miraflores the two locks are duplicated for the passage of vessels as at Gatun, and are similar in general character to those

at Gatun. The lift of the lower of the Miraflores locks is, however, variable, depending upon the state of the tide in the channel between it and the Pacific. The vessel entering this lock will, therefore, be subject to the flow of the tide, a current, it is estimated, of a velocity of about one foot per second in the canal. Originally the site of these locks was planned at La Boca, the outlet, but it was found that this was exposed to gunfire and other methods of naval attack, and in the interests of defence this arrangement was not carried out. The Miraflores locks are sheltered from the sea by the hills, lying as they do five miles inland.

The dams at Pedro Miguel and Miraflores are small in comparison with that at Gatun. They are founded upon rock, and will be subject to a pressure due only to a head of forty feet of water, instead of eighty feet, as at Gatun; and therefore no anxiety is occasioned thereby. In the event of the breaking of the top lock gate at Gatun, and of the emergency gates, so allowing the water of Lake Gatun to escape to the Atlantic, the lake would still remain 32 feet deep near the dam, and even large steamers would not be stranded. Further, so considerable is the volume of the lake, that it would only be lowered at the rate of two feet per day, and

more than three weeks would pass, it is estimated, before the waters reached that level. These conditions, however, are absent in the other dams, and if the water escaped vessels would be grounded, and a dangerous current generated.

It will be readily understood even by those unacquainted with engineering matters, that a canal rising and descending by means of locks requires a constant supply of water for replenishing that lost in the operation of locking. As vessels are passed through the locks a considerable quantity of water, equal to the volume contained in each lock between its high and low level, is lost, and if the canal in its high portion did not receive a further supply it would in time run dry. The replenishing of the water in the Gatun Lake was, of course, one of the matters to be taken into account in the high-level canal. The question of a sufficient or constant supply from the lake has been raised frequently. The Chagres River, which supplies it, is, in the dry season, a comparatively insignificant body of water, although it rises to a great flood in the rainy season. When it is low, the natives of the isthmus make use of its bed, in the upper part, as a highway in default of other roads. But during eight or nine months of the year the lake is kept constantly full by the

prevailing rains, and consequently the surplus necessary is required to be stored only for a few months.

The minimum run-off for the catchment area, recorded during the last twenty-two years, was in 1912, and, measured at Gatun, reached a volume of 132,000,000,000 cubic feet. In 1910 the run-off was 360,000,000,000 cubic feet, which was sufficient to fill the lake one and a half times. With 48 lockages per day, plus the water used for the turbines, and supposing the lake to be full at its highest elevation (of +87 feet) above sea-level, at the beginning of the dry season on 1st December, then, by 7th May, at the close of the dry season, it is calculated that the water would have become lowered 7½ feet (to +79·5). This would give a depth in the Culebra Cut of 39 feet of water, sufficient for navigation. Thus seven feet of storage is available until the time when the rains set in again, and making allowance for seepage, evaporation, and power consumption, the volume of water would be sufficient for forty-one daily passages through the locks, using the full length, or fifty-eight lockages using the partial length, as would commonly occur, in which latter case cross-filling from one lock to the other through the central wall will be employed. This would be a larger number of

lockages per day, however, than it is likely would take place.

At night-time the Canal will be lighted from one end to the other by gas and electricity, and along the course, commanding the various bends, are built concrete lighthouses in cleared spaces on the jungle-covered hills, for the range lights of the channel. In the Culebra Cut beacons are to be used, and floating light-buoys through the Gatun Lake, marking the channel. Electric light will be used in the towers, and compressed acetylene dissolved in acetone in the inaccessible places and buoys. Marking the channels of the Atlantic and Pacific ocean terminals will be very powerful lights, visible 12 to 18 miles out at sea. These lights will have combinations of flashes and dark intervals, so as not to be confused with the ordinary lights on shore. The most brilliant spots on the Canal at night will be the locks, where, mounted on high, handsome concrete columns, clusters of electric arcs will illuminate every portion of the apparatus.

As before observed, the operating machinery for the Canal gate is driven by water-power. This water passes from the lake through a culvert near the north wall of the spillway. The turbines actuated by the stream not only operate the lock machinery, but that of the machine shops and repairing appliances, the

dry dock, the coal-handling appliances, and the electric batteries for lighting the locks and the streets of the towns upon the Canal Zone, as well as operating the locomotives on the Panama Railroad. A hydraulic station to generate 6000 kilowatts stands near the spillway dam.

The successful and expeditiously performed work of building the Panama Canal is due in the main to the unremitting efforts of the chief engineer and administrator, Colonel Goethals, and of the chief of the Sanitation Department, Colonel Gorgas, M.D., seconded by their able staff of Americans. These two gentlemen have earned a lasting reputation and have placed American engineering and medical work, in that particular field, upon a high plane. The two branches of work, the structural and the sanitary, depended upon each other to a peculiar extent at Panama, as has indeed become a matter of history, and to the methods of the latter we shall now devote a chapter.

CHAPTER X

THE CONQUEST OF THE MOSQUITO

If the construction of the Panama Canal has been one of the greatest engineering enterprises that the world has seen, it is no less famous as a triumph of medical science and sanitation. The methods and discoveries under which the Panama Isthmus was rendered habitable for the foreigner, form one of the most interesting portions of the history of the work, and their results are of permanent and widespread value for regions beyond that of Central America, and will greatly influence the possibilities of the efficient development and populating of tropical lands in general.

It has been shown that the efforts of the French were in great part overcome by reason of the unhealthiness of the isthmus, and that, in the early part of their work, the Americans suffered from the same dangers and hindrances. The principal scourges were malaria and yellow fever. Although the last named has a more dreaded sound than the former, it

is not, perhaps, more serious in its ravages. An enormous total of deaths has been set down to malaria in the unhealthy and swampy countries of both the New and the Old Worlds. The word itself is of colloquial Italian origin, from *mala*, bad, and *aria*, air, and is similarly used in Spanish, its origin having been associated with miasmatic swamps. Yellow fever strikes almost a note of terror in the mind of the traveller, and is swift in its action. Malaria ruins the life of whole communities by slower degrees.

The French do not appear to have maintained any effective methods against these diseases. It is true, however, that neither the causes nor the remedies were then as scientifically known as they subsequently became; but under any circumstances it is a matter for great surprise that, relatively, so little was attempted. During the French regimen, of the Panama Canal Company and its successor, a total of 86,800 men were employed, giving an average per annum of 10,880. Of these 52,814 were treated for illness, and the number of deaths was 5627, a yearly average of 703 deaths and 6535 cases. In September, 1884, as showing the conditions on the isthmus earlier, the whole crew of a British brig died from yellow fever, and there were 120 cases in Colon, with a two-thirds mortality. In that

month, it is stated, the Canal Company buried 654 of its people.

Notwithstanding these conditions, the French Company only applied 2,000,000 dollars to hospital service during their operations, equal to about half of one per cent. of the total expenditure, with scarcely any allotment for sanitation. Further, under the American regimen in 1904–5, the 'Mosquito theory' was derided by many, and some of the employees on the isthmus 'even tore holes in the few wire screens that the Commission had allowed the sanitary corps to put up.'

Under the French, and even under the Americans, at first, the consideration of the value of human lives appeared to take less place than the consideration of the value of human property. This, however, is not surprising; it is interwoven in the history of the world, and as regards labour in any country, is even now scarcely beginning to receive its necessary economic (to say nothing of humanitarian) condemnation. Labour is exposed to dangers, difficulties, and even semi-starvation. Money is surrounded by safeguards. When, however, the deterioration of labour leads to undue pecuniary loss there is a tendency to bring about betterment. Thus it was on the isthmus, both in the sanitation

and nourishment of the labour; although of course the humanitarian element had its influence also.

At the beginning of 1904, when the first American commission began work on the Canal Zone, there were no cases of yellow fever or plague on the isthmus. The French and other foreigners had left the place, or had left their bones in the enormous cemeteries at Colon and Panama, which are still pointed out to the traveller. But a few cases appeared directly afterwards. In July of that year the American sanitary officers appeared. Under the executive order of President Roosevelt the best medical experts were sent out, but they were hampered by red tape, and the number of yellow fever cases increased, and panic followed.

It was at this period that Colonel W. C. Gorgas, M.D., took charge of the Department of Sanitation of the Commission. In his report he stated that 'the experience of our predecessors was ample to convince us that unless we could protect our force against yellow fever and malaria we would be unable to accomplish the work.' The native people of Panama were immune from yellow fever; it attacked foreigners only. In April, 1905, among the 300 non-immune employees of the commission, in the

administration building at Panama, there were 9 cases and 2 deaths; in May, 33 cases and 8 deaths. In June there were 19 deaths from yellow fever throughout the isthmus, and the commission reported that 'a feeling of alarm almost amounting to a panic' spread among the Americans on the isthmus.

Many resigned their position and went home, others became possessed of a spirit of lethargy or fatalism, believing that no remedy existed, and there was even a disposition to ignore or condemn and abandon all preventive measures. The gravity of the crisis was apparent to all. The total deaths from yellow fever among the employees of the commission in the twelve months from October, 1904, to September, 1905, was 37, among 17,000. This was low in comparison with the ordinary population of the isthmus, including the employees of the Canal work; among whom for the four months, May to August, there were 47 deaths, with 108 deaths from malaria. The moral effect of the sudden deaths from yellow fever was more marked than those from malaria, and very decisive action was necessary.

The battle against these scourges was entered upon resolutely and scientifically. It had by that period become known that both yellow fever and malaria are induced and

propagated by the bites of mosquitoes, of two different kinds. This fact had been demonstrated by a series of careful and accurate observations and experiments, carried out in different parts of the world by persons of various nationalities, and Panama was to benefit by the discoveries.

Malaria and yellow fever are, it has been found, caused by a parasite in the blood, into which it is introduced by the bites of certain species of mosquitoes. The first steps in the discovery of the relation between parasitic diseases and mosquitoes are comparatively recent. From the time of Hippocrates, malarial fevers were subject to observation, and various theories of causation were suggested, and some of them vaguely, but with surprising accuracy, anticipated the results of modern research; but it was not until the last decades of the nineteenth century that the true nature of the disease was revealed.

In 1880 the French army surgeon, Laveran, in Algeria, observed the living parasites under the microscope in the blood of a malarial patient. Soon afterwards Italian pathologists—malaria was of especial interest to Italians, in view of the devastated malarial regions of Italy—adopted this view. But the origin of the parasite in the blood was still unknown, although an old popular belief

in many countries connected malaria with mosquitoes.

In 1894 Sir Patrick Manson suggested that the malarial parasite was propagated outside the human body, and that its 'host' would probably be found to be a particular mosquito.[1] Then Major Ronald Ross, a Scotsman in the Indian Civil Service, following on these lines, found, in 1895–7, that if a certain genus of mosquito sucked malarial blood they imbibed the parasites, and in the malaria of birds he worked out the life history of the parasites. It was, he found, only the mosquitoes of the genus *Anopheles* which contained the peculiar cells, and even these did not get them when fed on healthy blood. From these discoveries to their application to the malaria of man was a natural step.

The conclusion deduced from the microscopical observations in the laboratory were confirmed by actual experiment, both by the Italian School and the London School of Tropical Medicine. Experiments were undertaken in the Roman Campagna during the severe malarial season. The observers escaped infection by protecting themselves from mosquito attack in a protected hut, whilst those outside suffered severely. Mosquitoes caught by the observers and sent to London, produced

[1] *Encyc. Brit.*, Vol. XVII.

malaria in persons who voluntarily submitted themselves to their bites at the London School of Tropical Medicine. Further experiments were undertaken on a large scale in the Campagna, with results that left no doubt whatever of the truth of the mosquito-parasitic theory of malaria.

The theory, so proved, that the mosquito acts as an intermediary 'host,' and transmits the parasite to human beings, explained various anomalous conditions regarding the occurrence of malaria. The disease was always associated with watery exhalations and with dew-fall, but it had been long noted that the passage of the infection seemed to be prevented by a wall of trees, or by clearing a space round a dwelling, in the brushwood, and that the 'miasma' of swamps did not act at a certain distance from the ground, but was nevertheless harmful even on ground at 7000 feet or more above sea-level, and especially in broken ground where stagnant pools existed. This is now explained, or very largely so, by the fact of mosquito-transmission, as the insects are incapable, owing to their small power of flight, of rising more than a few feet from the ground, and cannot make their way through a belt of trees of moderate thickness. Furthermore, they cannot fly more than a certain distance, and

if they are to breed over the face of a district, a chain of pools or swamps is necessary not farther apart than this determined distance.

The mosquito or gnat—the terms being synonymous—of the *Anopheles* genus have a wide geographical distribution in Europe (including England), Asia, Africa, and America. In colour, the *Anopheles* are usually brownish or slaty, sometimes buff, with a dark stripe on each side of the thorax, the wings having a speckled or dappled appearance. A distinctive characteristic is noted when the insect is at rest: 'the proboscis, head, and body are in a straight line, sometimes inclined at an angle to the wall, the tail sticking outwards.' It rarely bites by day, and some observers have stated that the insect does not 'sing' like other mosquitoes.

The preventive methods employed consist in destroying the breeding-grounds by draining pools and collections of water, or temporarily treating these with petroleum, which prevents the development of the larvæ; by protecting the doors and windows of dwellings by wire gauze, and by acquiring a certain amount of immunity by the systematic use of quinine, as well as arsenic. Exposure to chills and night air should also be avoided.

By the adoption of these preventive

measures, malaria has been greatly decreased in many places. At Ismalia, for example, as a result of mosquito reduction and the taking of cinchon or quinine, the 2250 cases of malaria in 1900 were reduced to 37 in 1905 in a population of 6000. Drainage work accounted to a large extent for this notable change. Probably, however, there are other factors still remaining to be discovered. Malaria seems to be, although rarely, existent where there are no mosquitoes. Also 'certain areas and certain islands are free from the disease, whilst neighbouring areas are devastated'; and the immunity appears to be due, not to the absence of conditions in favour of the disease, but rather to the presence of some inimical factor which prevents its development. It is this possible factor which it would be extremely valuable to discover.

Yellow fever is similarly transmitted by the mosquito, but the variety is that known as the *Stegomyia fascinata*, a domestic mosquito occurring endemically in certain regions. The disease, unlike malaria, does not occur in all tropical countries, and indeed was almost a product of the New World, the first authentic account of its existence having come from Barbados, in 1647, where it was described as a 'nova pestis,' and was connected, as to its origin, with the arrival of ships. The fever

ravaged at various times the West Indian ports, and those of Central and South America until very recent years. In certain places in South America it is still very prevalent.

During the great yellow fever period, from 1793 to 1805, the disease appeared at various seaports in Spain, and thousands of people perished. It has gone as far north as Quebec, and cases have even been known in Wales. But in Africa it is known only on the west coast, not on the east, and, remarkable as it may seem, in India the disease is unknown. Had it not been stamped out at Panama, it has been argued that yellow fever might have spread to Asia, with results easily pictured. The mortality from yellow fever is generally very high. In Rio de Janeiro it reached 94½ per cent. in 1898; but the death rate varies greatly.

Yellow fever was at first ascribed to almost similar causes as malaria—in miasmas. In 1881, Dr Charles Finlay brought forward the theory that the real carriers of infection were mosquitoes. This theory was neglected until the part played by mosquitoes in other tropical diseases aroused interest. Finlay indicated the *Stegomyia* as the agent, a black insect with silvery markings on the thorax, exceedingly common in the endemic area, and found generally in the towns

breeding in stagnant water about dwelling-places.

Experiments were made, by the method of catching the mosquitoes, causing them to feed upon yellow fever patients, and after keeping them a fortnight 'allowing them to bite susceptible individuals, who, for the purpose, were established in a camp, with other susceptible persons as a control.' Those bitten developed the fever, the others did not. After these experiments an American commission was appointed, and found that the *Stegomyia* was the true agent of infection. It was also found that the mosquitoes fed on yellow fever blood were not capable of causing infection until after a lapse of twelve to fourteen days, but that the insects retained their power for at least fifty-seven days. Such a period would thus permit the spreading of the disease by a voyaging ship in any part of the world.

It has been concluded, therefore, that the yellow fever virus is a parasite, and, as in malaria, requires 'an alternate passage through a vertebrate and an insect host.' The members of the French yellow fever commission to Rio de Janeiro, in 1906, discovered a curious fact in connection with the *Stegomyia*.[1] The female before laying

[1] *Encyc. Brit.*

her eggs must first have a feed of blood, and at that period she strikes both by night and day. Three days after her feast she lays her eggs, and then she strikes only at night. Thus, persons who may have been bitten by the insect in the day-time do not develop the fever, but those bitten at night do. This, to some extent, explains why it was dangerous for the European traveller to sleep in infected districts but not dangerous to visit such during the day, a matter not comprehended before.

When these discoveries about the *Stegomyia* were made known, a vigorous campaign was carried on by the American doctors in Havana in 1901. This was during the American occupation and cleansing of that city, after the war with Spain; and a campaign against mosquitoes, based on the methods applied to the suppression of malaria, was undertaken. This work was carried out under the direction of Major W. C. Gorgas, M.D., of the United States army, afterwards appointed to Panama. Considerable opposition was offered by the Cubans of Havana, who resented the necessary intrusion upon their domestic matters which the inspection entailed. But, following upon orders, all receptacles containing water were kept mosquito-proof, sanitary inspectors maintained constant house-to-

house visits, receptacles found to contain larvæ were destroyed, or fines inflicted, puddles and breeding-grounds were treated by draining and with petroleum; hospitals and houses containing yellow fever patients were screened with wire gauze, and buildings and outhouses fumigated with pyrethrum powder.

These matters, derided at first by the Cubans, and evaded when possible—Havana was one of the dirtiest and most unhealthy towns, and is a tideless seaport—brought about results exceeding all expectations, and, after January, 1902, yellow fever ceased entirely to originate in Havana. Similar results followed the new treatment elsewhere. Rio de Janeiro, which in thirteen years lost 28,078 inhabitants by yellow fever, began to be healthy, and the disease disappeared completely in 1909. In the West Indies and in New Orleans the methods were equally successful.

Thus, after the appointment of Colonel Gorgas on the Panama Canal Zone, the methods which had proved so successful against the two scourges were employed. The malaria mosquito or *Anopheles* breed in pools of fresh, stagnant water, where algæ and grasses grow, such as existed all across the isthmus; whilst the yellow fever mosquito or *Stegomyia* haunted the towns and dwelling-places, living

in rooms and outhouses. In April, 1905, the Sanitation Department had the large total of 4100 men under employment, solely upon these matters of mosquito extermination. All cases of fever were taken to buildings carefully screened in with gauze, as a protection from the mosquitoes, or if left in their own homes, the doors and windows of these were so screened. Fine-meshed copper gauze was used, as nothing else would resist the climate. The purpose of thus enclosing the patients was to prevent the infecting of healthy mosquitoes, and so preventing the spread of the diseases. All dwellings in Panama and Colon were fumigated with pyrethrum powder or with sulphur, and cleared of dust and refuse.

These operations, as in Cuba, were not performed without the derision, and often the resistance, of the native people of the town. The natives of such places, it is to be recollected, are themselves immune from yellow fever, which attacks foreigners or strangers; and as to malaria, centuries of its experiences had rendered them callous. Panama, when the Americans took control, was a picturesque but dirty town, along whose narrow streets ran open gutters in which refuse flowed, after the manner of Spanish-American towns.

A new water-supply for Panama was installed from reservoir and flowing mains, replacing the tanks, cisterns, tubs, jars, etc., formerly employed for domestic purposes; and the ruts and holes in the execrable streets and alleys of Panama and Colon were filled up and pavements substituted. Panama is a low-lying, picturesque, and not unattractive town, with many of the quaint characteristics and the old-world atmosphere of Latin-American cities, restful to the traveller after the more commercial aspect of North American towns. But it is subject to heavy rainfall, and is in a region of calm, lacking the salt-laden breezes of Colon, which beat ceaselessly upon the shore of that Bay, and to some extent purify the city from exhalations.

For the destruction of the malaria mosquitoes, pools and swamps were drained as far as possible, and when this was not practicable they were oiled constantly. The *Anopheles* is almost entirely a mosquito of country districts, but Panama, Colon, and some forty or more small towns and villages along the Canal were all exposed to the disease. Advantage was taken of the fact that the flight of these insects is at most 200 yards, and therefore by destroying the breeding-places within such a radius immunity is

attainable. This, of course, was impossible in many cases, and reliance was largely had upon screened buildings.

The methods employed to destroy the breeding centres of the *Anopheles* consist in cutting down the jungle or brushwood and grass, a *machete*—the universal jungle-clearing cutlass of Latin America—being employed in the expert hands of the native woodmen, and in cleansing streams and ditches and pouring heavy oil upon the waters of natural and artificial streamways, in filling in or stopping the holes of land-crabs and other vermin; and in draining the soil, preferably with tile-drains in the subsoil, such positive drainage being the only permanent method of making the soil unfit for mosquito breeding. Even the very smallest puddles will form breeding grounds for the larvæ, and a troop of negroes was employed, with cans of larvacide on their backs, which they sprayed into stagnant pools and backwaters. At the heads of rivulets and streams iron cans were placed on planks spanning the water, and from these cans a piece of overhanging wick caused the oil to drop and spread. The material was composed of crude carbolic acid, resin, and caustic soda. To attend to these matters was the work of the *Anopheles* brigade, whilst in the vicinity of Panama and

other places, the *Stegomyia* brigade was in charge.

Added to the efforts of the malaria brigade was the antidotal effect of 'cinchonisation' by quinine. This invaluable drug, it will be recollected, was a product of Peru in viceregal days. The wife of a Peruvian viceroy, the Countess of Cinchon, fell ill of a tertian fever, or malaria, and was cured by the native remedy, consisting of doses of the bark, and this bark was named after the lady. Very heavy doses of quinine were given by the American doctors at Panama; far heavier than is the practice of English doctors in India.

Thus the practical study of entomology aided engineering science. It is recorded[1] that the first shipload of European labourers who arrived, and who were quartered in unscreened buildings, suffered to the extent of 33 per cent. of their number being attacked with malaria. The second shipload, housed in screened buildings, had only 4 per cent. of their number so attacked. During 1906, with 26,000 men at work, there were 21,740 cases of malaria admitted to the hospitals. The death-rate from this disease was 2 per thousand among whites and 8 per thousand among

[1] *The Panama Canal and its Makers*, Dr Vaughan Cornish.

negroes. In 1907, with 39,000 men there were 16,750 cases, and the negro death-rate fell to 4 per thousand. The total death-rate from all causes, including malaria, in that year was given as 16·7 per thousand for white employees, and 33·3 for blacks, or 28·8 per thousand for the total; but a large number of these was due to accidents.

Of the American women and children in commission quarters at that time there were 1337, with 9 deaths; an annual average rate of 6·73 per thousand. In 1908 the death-rate among the average number of white workers employed was 15·34 per thousand, and among the 5000 American employees, 8·14 per thousand. Among the blacks, averaging 31,000, the rate was 19·48 per thousand, or less than that of the city of New York. In the following year, 1909, still better conditions prevailed. The total admissions to sick-camps and hospitals reached 46,194, or 23·49 per thousand of the force on the pay roll, the majority, however, being trivial cases. The total number of deaths was 530, equal to a low death-rate of only 11·97 per thousand.[1]

This great improvement in the vital statistics of the isthmus was partly due to better feeding, as described later. Among

[1] *Panama and the Canal of To-day*, Forbes Lindsay, 1912.

the 40,000 employees during the year ending June, 1912, 7000 cases of malaria were in the hospitals, with 32 deaths, of which 22 were white people; which contrasts remarkably with the 21,740 cases in 1906. Among the 'screened' Americans the death-rate was reduced to 3·94 per thousand. When it is recollected that the death-rates of London, Paris, and New York respectively are 15, 17, and 18 per thousand, it is seen that the claim for Panama as 'one of the healthiest places in the world' is not altogether an exaggeration. It was estimated that the total expenses of the Sanitary Department amounted to 20,000,000 dollars, or over 5 per cent. of the cost of the canal.

The difficulty of entirely stamping out malaria is partly that a malarious person, it is believed, remains infectious to the *Anopheles* for three years (instead of the three days of yellow fever); and thus to reach a 'millenium' when both mosquito and infection shall have disappeared, seems impossible.

A further disease on the isthmus, which especially attacks black labourers, is that of pneumonia, to which is attributed a considerable death-rate. This disease results generally upon a poor standard of living, and certainly could be eliminated. Doubtless it will be eliminated, whether in Central America or

elsewhere in South America, where both pneumonia and malaria (or paludismo, as in Peru) take heavy toll of the poorer population; but this will not be until a true economic regimen replaces the present haphazard conditions of life as regards the conditions of labour.

The results reached on the Canal Zone are of much value as concerns the peopling of the tropics; and indeed open up great possibilities in this connection. Regions considered non-habitable by the white races may now become free from diseases of this character, if such methods are practised.

CHAPTER XI

LABOUR CONDITIONS

One of the most instructive features in the building of the Panama Canal, was the carrying out of the work under what might be termed an experiment in collective activity under an autocratic regimen. A remarkable lesson in administration was learned as a result. It was early seen by the Americans, that their habitual over-individualised methods under ordinary civil control would never accomplish the work. In the first place, the tenders for construction by ordinary contractors were unsatisfactory, and had to be rejected. In the second, the administration of the enterprise by the commission of seven first appointed, was found to be unsatisfactory, the various authorities clashing with each other, subject to political influences and influenced by the popular American clamour unduly to hurry on the work. Under such conditions corruption, or 'graft,' as the American term has it, would undoubtedly have arisen, and indeed did begin to show itself. The American

character is often defiant and impatient, but it generally respects an absolute 'boss,' not out of fear but native wisdom, and this explains the absence of the revolutionary habit in the United States. It was seen that only under a strong central or single administration could harmony be secured.

It was due to these growing convictions, and to the fact that the President of the United States, Mr Roosevelt, and the Secretary for War, Mr Taft, were desirous of trying the method of administration and construction by military engineers, that an army officer, Colonel Goethals, was appointed in full control as absolute administrator, with the entire commission subordinated to him as Chief Engineer. Such a condition cannot be regarded as establishing a general precedent for such work. An administrator and an engineer, in general, are each predominant in their respective fields, as are the captain and chief engineer of a steamer, with the former paramount; and it was not only in the system so employed, but in the man whom good fortune supplied to fill it that brought success at Panama.

The praises of Colonel Goethals' administration have deservedly been sung by every writer on the subject of the canal. This form of autocratic management incurred at first considerable opposition in the United States. In

a land where individualism has become almost a fetish, where the individual has been permitted to run riot in the exploitation of the community (as exemplified by trusts and numerous matters), and where the 'independent' character of the modern American prevails, it was not likely that such a course would be accepted without bitter protest. The President sought to obtain authority from Congress for the purpose, but failed, and only carried his point by an exercise of executive authority.

Under this type of administration both the expenditure of the enormous sums necessary for the work has been managed with at least the greatest economy compatible with efficiency, and, in addition, the co-operation of all workers, and a generally satisfactory state of judicial administration, was secured, to which result the personality of the Administrator-Engineer in no small degree contributed. From the time of the appointing of a single controlling head there was no question as to who was 'boss,' nor misunderstanding as to the issuing of orders, nor doubt as to their execution. The whole operations moved 'swiftly and with precision, directed by one mind and free from the disturbance of conflicting purposes.'

An instructive feature of the work was the

accentuation of a very human and almost pathetic fact. Stated in simple terms, this was that men cannot work efficiently without sufficient food. This fact was rendered very evident in the treatment of the West Indian negroes, who were employed in great numbers. In 1906 the Commission were profoundly dissatisfied with the work of these labourers, who formed the majority of the navvies under the French regimen; and it was reported that 'another year's experience with negro labourers from near-by tropical islands and countries, has convinced the Commission of the impossibility of doing satisfactory work with them. Not only do they seem to be disqualified by lack of actual vitality, but their disposition to labour seems to be as frail as their bodily strength.'

This unsatisfactory condition arose from two causes. The more important was a lack of sufficient food; but it was some time before this very primitive condition was discovered. The food eaten by the negroes was bad in quality and insufficient in quantity. When this was realised the condition was remedied by providing them with properly cooked meals, as in the case of the American and European employees, and in order to ensure that they should profit by the provision, the charge for the meals was

deducted from their wages. The purpose was not to make any profit out of this catering, but to ensure that the men should be properly fed.

The cost of providing the messes for the European and negro labour was given in a report in 1909, and for six months of that year reached 719,000 dollars as against 716,000 dollars for takings from the sale of the meals. In 1907 the number of meals served reached nearly a million per month, and rose considerably afterwards. At that time there were numerous hotels for white Americans thus controlled, where good, wholesome meals were provided for 30 cents each (1s. 3d.); and for European labourers, where a day's board was furnished for 40 cents; and numerous kitchens for the West Indian labourers with the day's board at 30 cents. The excellence of these Government kitchens was shown by the fact that out of 4800 European labourers, who were free to eat where they desired, 3400 preferred the official mess-halls.

Under the system, the disparagement which had been visited upon the West Indians disappeared, and much more favourable accounts were heard. The negro became stronger, and worked with a better will. The handful of bananas or other insufficient

food which—as a result of his own laziness or the lack of organisation, as well as the relatively high price of food in small restaurants—formed his diet, gave way to meat and other foods, with a corresponding increase of his bodily powers. In Barbados the negro earns perhaps a shilling a day during the short season of sugar-culture or harvesting, and little else beyond, and lives under the most primitive conditions as regards housing; but on the Canal Zone he earned 10 cents (or 5d.) per hour for an eight-hour day, with 30 cents only deducted for three good meals; whilst his lodgings were sanitary and free. The providing of a solid meal for a navvy at a cost of 5d. in a place such as Panama, where all stores were expensive, is certainly instructive in the art of catering.

A further condition in the betterment of the position of the West Indians was in their treatment by their white American foremen. The 'British' negro is of independent character but of a happy disposition, and fully amenable to kind, firm treatment, such as under the 'Imperial' conditions of Barbados and elsewhere under British control he generally obtains. But the American foreman did not know how to treat these people at first. The conditions in the United States as regards negroes are very different, and the character

of the American negro is also different. The bullying tactics of the white American foreman were deeply resented; and the rigid conditions of the 'colour line' as practised in the United States was not understood by the British negro, accustomed to the different secial conditions governing the relation of white and black in the British colonies. To control these negroes was an art the Americans had to learn, and when it was learned far more satisfactory conditions prevailed.

Thus it was that under the rational conditions of diet and control the formerly despised British West Indian negro came to form perhaps the most valuable element of labour in building the Canal. Before that result was reached the importing of some thousands of Chinese labourers was contemplated, but happily not carried out. The improving conditions resulted in a larger influx of European labour, the majority coming from Greece, Italy, and Spain.

The Spaniards and Italians were found physically superior to the Greeks. A large proportion of the Italians was migrant labour, part of that floating population of South America, of excellent physical capacity, which oscillates between the various republics. But the Italians gave some trouble by their capacity for collective action when

dissatisfied—a condition which has also been marked in strike riots by Italians in the United States. Their numbers were reduced from this cause. The Spaniards were principally from Galicia and Castile, and at certain periods they constituted five-sixths of the European labour. They were of excellent stamina generally, and not prone to disorder collectively, due to the fact that they came directly from their villages. They were regarded as sober, quick to learn, patient, and generally civil, and they appeared to stand the tropical heat better than did any labourers of northern race.

Justice and the amenities were equally well served and regarded. Various enthusiastic writers have devoted chapters to the kindly or paternal methods of the administrator of the Zone, Colonel Goethals. This official established a kind of open court on Sundays, for hearing informally any grievances of the employees, irrespective of station or race. The white skilled employees including mechanics, under the regimen established, generally performed their utmost to fulfil their part, often in a spirit of patriotic enthusiasm, each feeling himself a unit in the machinery of progress, and regarding this as a reward beyond his mere wage. The white employees, however, did not remain

permanently on the Canal, but changed constantly; the Americans going back to their homes.

A feature of the control of white labour on the isthmus was the full recognition accorded to trade unions, and the adoption of the eight-hour day. The American mechanics, such as those in control of steam shovels and other important machines, and others who were on what was termed the 'gold roll,' received as a rule 65 cents an hour. The trade unions took a prominent part in the matter of the conditions of such labour, and partly due to their action it was that no Chinese were imported into the Zone.

Work of so rapid and strenuous a nature was not carried on without loss of human life and limb. Disasters occurred from landslides, which towards the close became frequent, from train accidents, and from dynamite explosions. In one instance, as before described, in June, 1912, a steam shovel working in the Culebra Cut was overwhelmed by a mass of rock and earth from the bank above. On this occasion, however, the men operating the machine saw the danger, and escaped with their lives. So severe was the force of the slide that the machine became a total wreck.

The deafening noise going on in the Cut

at times drowned the noise of the moving trains, and switchmen were frequently run over and killed; whilst the roughly-laid temporary tracks occasioned jolting of the trains, throwing men off at times. Collision and the jumping on and off moving trains added to the casualties, and there have been a total of about 150 deaths due to the railways. Whilst there were accidents from explosions, it is held that the percentage of lives lost was lower on the Canal than upon other large works. In using 10,000,000 pounds of dynamite in 1911 only 10 lives were lost. In 1909, however, a charge of 44,000 pounds of dynamite, which had been charged into 53 holes, at Bas Obispo in the Culebra Cut, exploded prematurely, and there were 26 deaths, and a number of injured. Elsewhere 12 tons of dynamite exploded, it is stated, due to the effect of a flash of lightning, and 8 men were killed. Accidents through misfire also occurred, and explosions have been even caused by a steam shovel digging into unexploded dynamite charges.

With 35,000 men employed it was but natural that accidents should occur. The comparatively low death-rate from such on the isthmus has been due to the fact that it was a Government work and not private

contract work, and that precautions for safety were strictly enforced. The low casualty rate compares strikingly with the terrible annual slaughter on American railways in the United States, due largely to negligence or parsimony on the part of the railway companies, a condition from which all private-owned railways suffer in greater or less degree.

The West Indian negroes do not remain on the isthmus, but seek their homes again, and there must inevitably be a considerable exodus of these people to Jamaica and Barbadoes again. The negro regards himself as an 'Englishman,' and is proud of his nationality. But the advent of so many into the West India islands must give rise to some perturbation in the labour market there. It was calculated in 1911 that, by the middle of 1913, the labour force on the isthmus would be reduced to 20,000 men. But near the latter date there were still 40,000 men working every day on the Canal. Of these 30,000 were West Indian negroes, with 4000 Spanish labourers, and 6000 white Americans in administrative and commercial positions on the work. The negroes are to be repatriated, or may go to Central American banana and other plantations, but they are aware that the pay to be received there, and the conditions

of their life and labour will be inferior to those enjoyed on the Canal.

The work remaining to be done at the terminals may occupy some 6000 labourers for some time, but the remainder must leave. The problem for their disposition by the Barbados Government will require care. These negroes have been 'educated,' as far as their wits were concerned, by the daily contact with Spaniards and Americans. The population of Barbadoes is already a large one, and the streets of the cities teem with negroes. The situation may be relieved or postponed by the employment of more men than was anticipated in finishing the subsidiary works of the Canal after the opening of the waterway to navigation; and the repatriation may extend over a year or more. The same question, although less acutely, occupies the mind of the American employees on the Canal—engineers, administrators, and labourers—as to what they shall do when their work is finished.

The Canal Zone will doubtless be turned into a military reservation, and no settlers allowed upon it. Provision for the West Indian negroes ought to be made upon broad, new lines. The plantations of Costa Rica, and other Central American states might absorb some of them—at the low wages and poor

conditions of life and semi-serfdom which prevail in those lands—but even this offers only a small field, as the supply of labour is not scarce in those places. In British Honduras a plan of homesteading was recently inaugurated, under which all British subjects prepared to live upon and cultivate the land would receive land free. But the canal labourer is not a tiller of the soil; land alone would not attract him. It is useless to create a class of slatternly, half-starved smallholders anywhere. What is required is the real organisation of local industries—a real science of industry planning.

The 'paternal' character of the administration authorised and insisted upon by the United States Government on the Canal Zone aroused some opposition on the part of those who would have preferred to exploit the workers, but these protests had little effect. As a rule, a construction camp is controlled by no moral laws or comprehensive system of organisation, as concerns the life and supply of labour. The conditions of such are generally just good enough to attract labour, with sufficient facilities for drink, gambling, and prostitution to hold them, and to relieve them of their money after it is earned. The Canal organisation was the absolute reverse. Upon the Zone no elements of this nature were

permitted to exist, although they could not be prevented outside, where serious evils existed. Not only were food and shelter provided, but schools, churches, meeting halls, clubs, libraries, and so forth. The work of social organisation was to a large extent placed under the control of the Young Men's Christian Association, with excellent results.

The people of the Canal Zone were absolutely dependent upon the outside world for food and clothing, as nothing was produced upon the spot. But the commissariat, or established supply department, did away with all middlemen's profits, buying in large quantities for cash, and obtaining lowest prices, and establishing central markets. There were eighteen of such throughout the whole Zone, and there the housewives and canal and railway workers did their shopping.

The administration of the Zone owned twenty-six church buildings, and paid salaries to fifteen clergymen, and the other fourteen church buildings were to some extent dependent upon Government favours. Of the total of forty it is interesting to note that seven were Roman Catholic, thirteen Episcopalian, seven Baptist, two Wesleyan, and eight undenominational. The 'architecture' evolved upon the Zone was of a new and distinct type, obeying the exigencies of

sanitation and climate of a tropical character. The buildings might be described as great wooden boxes, whose distinctive feature was the broad, screened balconies, covered with wire netting to exclude mosquitoes, somewhat relieved from their stiffness and monotony by painting.

The composite character of the inhabitants of the Zone may be judged by the fact that of the population of the town of Empire, of somewhat over 7000 inhabitants in 1912, there were 1700 whites, nearly 4000 negroes, 1500 mestizos, 100 Chinamen, and 25 East Indians, with a sprinkling of Arabs, Syrians, and others. On the outskirts of the town, occupied by the part of the population not employed by the Government, were Spanish cantinas, American 'saloons,' Chinese shops, East Indian fancy work-shops, and negro tailors and shoemakers. Beyond were the huts of labourers who preferred the half-jungle life of freedom, picturesque, but with the accompaniment of squalor and discomfort, in great contrast with the orderly and almost smug aspect of the organised portion under the administration.

It is not to be supposed, however, as has picturesquely been asserted, that the canal was built by men from all parts of the world. Three nations almost alone have furnished

the labour—British, American, and Spanish. Other nations had supplied a mere fraction, and in 1912 75 per cent. of the workers were negroes, West Indian British subjects, with the Caucasian race represented by the American and Spanish, and a few Italians. About 300 East Indians, a few Greeks and other Europeans, and one Japanese represented the other peoples of the world. Since 1906 about one-seventh of the total were white Americans, one-seventh European labourers, and five-sevenths West Indian negroes.

Recruiting was constantly necessary to maintain this force; about half the arrivals coming by reason of agents, and half independently. At the time when the negro labour appeared to be inefficient, a condition which was remedied by better treatment, preliminary steps were taken to secure a supply of Chinese labour. A strong protest from the labour unions of the United States, supported by California, whose aversion to Asiatics is well known, happily prevented this. There was no element more law-abiding and peaceable than the West Indian negroes, and the Americans have recognised the debt they owed to the British West Indian Governments for the character of these people. Conversely, the negroes have gained a distinct economic progress under the term of their employment on the Canal Zone,

for which full acknowledgment is due to the Americans.

Some inevitable problems have arisen from the system of education maintained on the Zone. The rising generation, it is stated, began to show a distaste for manual labour, which may lead to over-competition in the future in clerical work and professional employment. It is natural that the political economy of a formerly backward people has been disturbed. The standard of wages and of living has been of necessity artificially inflated, and must sink again to some extent when the work is done. After the French exit famine seized the population. The situation calls for the exercise of a new principle and method of economic organisation.

CHAPTER XII

GEOGRAPHICAL ADVANTAGES

It will now be necessary to examine the economic, strategic, and other advantages of the Canal for the maritime, exporting, importing, emigrating, and travelling nations of the world.

The primary object of a ship canal is, of course, to shorten distances for vessels. Ship-freight is cheaper than railway freight. Before the building of the Canal, freight could only cross the isthmus by means of transhipment from steamer to train on the Panama railroad, and thence to steamer again. The cost of transhipment is a very large item in the total carriage costs of goods. As regards passenger traffic, it will of course be a vast convenience and comfort to perform a continuous voyage on one steamer from Europe or New York into the Pacific, and to San Francisco, British Columbia, Callao, Valparaiso, etc., and thence along the great trade routes to Asiatic ports, China, Japan, and so forth, without changing at Colon, and without

going far south to traverse the cold and stormy regions which have their passage in the Straits of Magellan, or the Horn. The use of the Panama Canal will render possible for the first time (with the exception of the impracticable North-West Passage, only once traversed so far) the circumnavigation of the globe north of the equator.

The principal reduction of distances due to the Canal is that between the Atlantic and Pacific ports of North America. From New York and ports north of it—Quebec, Montreal, Boston, Halifax, and others—the distance to Panama and all ports north of it, such as Acapulco, San Francisco, Puget Sound, Vancouver, Prince Rupert (the terminus of the new Grand Trunk Pacific Railway), and others, will be reduced by slightly more than 8400 miles; which figure represents the present circumnavigation of South America to Panama from the present route of steamships. This is the maximum shortening. For all the Pacific seaports of South America the saving naturally decreases in proportion with their distance from Panama. Thus the shortening to Callao, Iquique, and Valparaiso decreases to a minimum of 1000 miles at Punta Arenas, the growing seaport in the Straits of Magellan, the most southerly in the world.

Similarly, the Panama Canal shortens the

distance from Europe to the Pacific coast of the Americas, but in a lesser degree, as against the Magellan route. From Liverpool, and with slight variations, from London, Hamburg, and Antwerp, etc., the reduction effected to Panama and all Pacific American ports north thereof is slightly over 6000 miles. To ports on the Pacific coast of South America the saving varies, as before, reaching zero at Punta Arenas. Colon is 1960 miles from New York and 4720 miles from Liverpool; so that the Pacific coast of America is now much nearer, by direct voyage, to New York than to Liverpool, which was not so before the building of the canal. For it is to be recollected that steamers both from New York and Liverpool had to pass the easternmost point of South America, at Pernambuco, near the equator, which point is 4066 miles from Liverpool and 3696 miles from New York—a difference in favour of the latter of only 370 miles. The South American continent, it will be remembered in this connection, lies almost entirely east of the North American continent, which brings Brazil so relatively near to Europe. Lisbon is several hundred miles nearer than New York to the coast of Brazil. Now a steamer course nearly due north and south, via the canal, embraces the east coast of North America and the west coast of South

America. New York, for example, is slightly west of Iquique, and Washington is near the meridian of Quito.

As regards distances from Europe to Asia, the Panama Canal offers little or no advantage over Suez. A vessel from Liverpool, Hamburg, Antwerp, Lisbon, or elsewhere, gains nothing by sailing westward for Asia instead of eastward, as at present, as the Panama Canal route is longer than the Suez Canal route. Further, there is no gain by the Panama Canal between England and Australia. To some of the New Zealand ports the distance is slightly less, but the Panama Canal will not bring any port in Asia, or the islands of Asia, such as Japan or the Philippines, nor yet the East Indies, any nearer to any European port. The only exception beyond that of New Zealand is the ice-bound portion of Siberia, where it approaches America.

But although Europe does not gain in these distances, the United States does greatly, by using the Panama instead of Suez, the route, as is shown by the following distances.[1]

From New York to Yokohama, via Suez, is 13,564 miles, and via Panama, 9835 miles, giving a reduction in favour of the Panama route of 3729 miles. From New York to

[1] *The Panama Canal*, Dr Vaughan Cornish.

Shanghai, via Suez, is 12,514 miles, and via Panama, 10,885 miles, with a reduction of 1629 miles. From New York to Sydney, via the Cape of Good Hope, is 13,658 miles, and via Panama and Tahiti, 9852 miles, with a reduction of 3806 miles. From New York to Melbourne, via the Cape of Good Hope, is 13,883 miles, and via Panama and Tahiti, 10,427 miles, with a reduction of 2656 miles. From New York to Wellington, New Zealand, via the Straits of Magellan, is 11,414 miles, and via Panama and Tahiti, 8,872 miles, with a reduction of 2542 miles. Thus it is seen how considerable is the saving by the Canal from New York to those important places. But to ports farther north in Pacific Asia there is no gain. Thus, from New York to Hong Kong, via Suez, is shorter than via Panama, the distances being 11,655 miles and 11,744 miles respectively. To Manila there is a gain of 16 miles only by the Panama route from New York, the distances being, Panama, and thence via San Francisco and Yokohama, 11,585 miles, and via Suez, 11,601 miles. Via Panama, Honolulu, and Guam the figures are 11,729 miles.

The Panama Canal route leaves unchanged the relative distances to the Atlantic coast of South America (Brazil, Argentina, the Amazon, the River Plate, etc.), to Africa, and

to Asiatic ports south of Shanghai. Their distances from New York and Liverpool are unaffected. But Yokohama, Sydney, and Melbourne are now nearer New York than Liverpool; and Wellington in New Zealand, nearly equidistant before, is now 2739 miles nearer New York than Liverpool. Liverpool, however, is still 295 miles nearer to Shanghai than New York (via San Francisco). Thus, the distance from New York to Yokohama, via Panama, San Francisco, and by great circle, is 9835 miles; and from Liverpool, via Suez, Aden, Colombo, Singapore, Hong Kong, and Shanghai, 11,640 miles, or 1805 miles in favour of New York. From Sydney to New York via Panama and Tahiti being 9852 miles, and from Liverpool via Suez, Aden, Colombo, Adelaide, and Melbourne, 12,334 miles, there are 2382 miles in favour of New York. From New York to Wellington, New Zealand, via Panama and Tahiti being 8872 miles, and from Liverpool via Panama and Tahiti 11,681 miles, there are 2759 miles in favour of New York. This last figure is made up of: Liverpool to Colon, 4720 miles, New York to Colon, 1961 miles, difference 2759 miles, the subsequent routes, being identical.[1]

That portion of the earth's surface in

[1] *The Panama Canal.* Dr. Vaughan Cornish.

which some of the important Asian and Australian places above mentioned are situated, a vast block lying between 120° and 140° of latitude east of Greenwich, and parallel 40° of north latitude, and 40° of south latitude, is of special interest as concerns the Panama Canal. A line passing there-through, running somewhat west of north and east of south is equidistant from New York and Liverpool, the first via Panama, the second via Suez. The Zone contains Japan and Korea, Shanghai, and the Philippines, New Guinea, and most of Australia.

An important North American seaport that will gain as regards its position by the Canal, is New Orleans. At present this place, and other ports in the Gulf of Mexico, are farther than New York from such ports as San Francisco and Valparaiso, and other Pacific American ports, and from Yokohama and Shanghai. But they are 580 miles nearer Colon, and therefore, by the Panama route, are that distance nearer to the western American and the Asiatic ports mentioned than New York, and to Sydney, Melbourne, and Wellington. It was stated long ago by an American economist that a ship-railway at Tehuantepec would practically be 'a continuation of the Mississippi River into the Pacific Ocean,' and the same argument

similarly applies to the Panama Canal. The improvement of the Mississippi fluvial system and the numerous products of its great valley are, it is held, likely to cause increased traffic from New Orleans.

It is shown by the figures of distances that the British Australasian dominions are brought much nearer to the United States eastern ports. Instead of being 1000 miles nearer to Liverpool than to the eastern seaboard of the United States, they will be, in some cases, 2500 miles nearer New York than Liverpool. Much has been made of the effect on 'Imperial' relations of this change by some writers, but it is difficult to think that any fundamental difference will arise therefrom. It has long since been shown that the solidarity of the British Empire does not rest upon trade. Commerce will inevitably seek certain natural channels, as long as import and export trade exists. Energy and excellence will always count, and to those trading nations who display this will belong the spoils.

Moreover, if Australia is, by the topographical change of the isthmus, placed under some competitive conditions as regards British trade, another part of the Empire, that of British Columbia, is greatly benefited. Vancouver and eastern Canadian ports generally benefit in their shortened distances from

eastern American and with Europe, the necessity for vessels doubling the South American continent being avoided. The effect on Western Canada is likely to be a marked one. The distance from British Columbia to the eastern ports of Canada and of the United States will be shortened by about 8000 miles; and to Liverpool more than 6000 miles.

It is reasonable to assume a growth of trade with British Columbia, due to lowering of freight costs, and the consequent cheapening of products, and the greater facility of obtaining business for the return voyage. The Mississippi Valley, and even the Orinoco and Amazon valleys, will be similarly rendered more accessible to the special products of British Columbia. British Columbia is a peculiarly favoured land in many respects. Its civilisation is markedly British; its climate resembles that of the British Isles to a large extent—the Japan current performing, in this respect for that coast, what the Gulf Stream performs for Britain, affording thus a temperate environment, with its corresponding effect on the human element.

It is generally considered that the British possessions of Jamaica, and other of the West Indian Islands, are to benefit materially by reason of the operation of the canal, lying as

they do in the 'American Mediterranean' in the path of a great trade route through the Canal. Kingston, the chief port, is 550 miles from Colon. The West Indian Islands are regions of great interest and capabilities. The black labour furnished for the construction of the Canal was of the utmost value, as elsewhere described, when adequately treated. The British negroes, however, do not settle on the isthmus, but prefer to return to their native islands.

The problem of adequately disposing of these teeming black populations is one which must exercise the statesmen of these islands in the future. A more intensive cultivation of the soil will yield a great variety of food products, but it cannot be said that Britain has efficiently supported these colonies. The cities of these British Crown Colonies are in many cases veritable revelations to the traveller, in their modernity, but the black population is greatly in evidence. All these beautiful islands of the Antilles and the West Indies should become better known and their resources more greatly utilised by reason of the probable commercial development of the 'American Mediterranean.' Their climate and scenery are often of the most delightful. Jamaica, Barbados, Cuba, and all others have never received their full meed

of attention. Trinidad lies in the mouth of the great and still little known Orinoco—that river of which Columbus wrote to the King of Spain that he had discovered 'one of the great streams flowing from the earthly paradise.'

In view of the utilities of the Canal the British harbours in the Caribbean Sea have been re-surveyed by the imperial authorities, and proposals made for establishing coaling and oil-bunkering stations, as at Carlisle Bay, Barbados, St Lucia, and docking and repairing facilities at Kingston, Jamaica. The British steamship lines using those regions have also surveyed the field for necessary developments in their services. It is, however, easy to exaggerate the benefit to be derived from the Canal by the British West Indies. Mere coasting-stations will not greatly advance them, and the various islands are widely scattered.

In the Pacific the Hawaian Islands are among those lands which should draw benefit from the Canal, lying as they do at the cross-roads of the Pacific. Their position is a peculiar and valuable one in regard to ocean routes, and the Americans, under whose control the islands are, look forward to considerable developments. It is natural to assume that a great naval base for the United States fleet

may be the outcome of American control of these islands and the opening of the Canal. The islands lie 4600 miles westward from Panama, and their climatic conditions and natural resources, together with great scenic and other attractions, render their possession of great potential value.

The annual export of products from Hawaii to the United States reaches the value of 46,000,000 dollars, three-fifths of which is for the ports of the Atlantic seaboard. This freight is carried at present via the Tehuantepec railway, from Salina Cruz, and it is argued by the patriotic Americans of Hawaii that its cheaper route would be via the Canal. In anticipation of greatly increased trade, the American Hawaiian Steamship Company is building five 10,000 ton steamers as an addition to its fleet, which at present trades between Hawaii and the United States.

Other islands in the Pacific which may be expected to acquire some strategic importance due to the canal, are the Galapagos. These islands lie off the coast of Ecuador, to which country they belong. They comprise a group of five large and ten smaller islands, the nearest being 580 miles from the mainland. The total area of the group reaches some 2800 square miles. The Galapagos lie exactly under the equator, and derive their name from the

species of giant tortoises which abound there. They are in the direct route of vessels crossing the Pacific Ocean and approaching Panama from New Zealand and the south-west, and so, in a sense, might be said to command an approach to the Canal from the Pacific side. The climate of the archipelago is tempered by the cold Peruvian current which sweeps up from the south, and its natural history—its flora and fauna—is of much interest owing to the isolated position, which has rendered its species immune from interference or interchange.

There are various British-controlled islands in the mid-Pacific which may be influenced by the Canal; among them Fanning Island, a few degrees north of the equator, and near the meridian of Hawaii. This island is the junction of the Pacific Cable Company's lines, and the establishment of a naval base there has been discussed.

It is to be recollected, in considering the advantages of the Canal as regards the two coasts of North and South America, that these are united by various transcontinental railway lines from the Atlantic to the Pacific, and that these railways will undoubtedly strive to enter into competition in the carriage of freight with the Canal. Time and distance of travel by the North American railways are

naturally much shorter than by the Canal. There are two such railways in Canada, the Grand Trunk Pacific, almost completed, and the Canadian Pacific. In the United States there are six such railways; in Mexico and Central America there are several more, including the Tehuantepec Railway.

All these, especially the last-named, are likely to compete for business as against the Canal. It is not rational to suppose, for example, that the producers of goods or foodstuffs in the interior of the United States could reap much advantage from the Canal as regards shipments to United States ports. Thus Californian fruit growers, or the mine-owners of Colorado would scarcely send their products to a Californian port for shipment to New York via Panama, nor would manufacturers in Pennsylvania and the eastern or middle states ship goods from New York via Panama for the western states, as this would involve double handling.

The transcontinental railways are the natural route for such home commerce. Furthermore, it is possible that improvements in railway traffic in the future may tend to lower railway rates, although the reverse has been the case so far. As regards passenger traffic, it is the case that where both sea and railway routes are available

passengers generally prefer the latter, both by reason of the saving of time and from inclination. An example exists in the service between New York and Vera Cruz, in Mexico, the port of the city of Mexico; and the same might be said of London and Scotland. People prefer the railway wherever such is available. There are, however, bulky raw products and manufactured articles which undoubtedly will find the sea-route economical between eastern and western coasts, and vice versa.

The Tehuantepec Railway has proved to be a successful undertaking since the line was rebuilt and the terminal ports constructed. The traffic across the isthmus increased from 145,000 tons of merchandise in 1906, to 460,000 tons in 1911, due partly to sugar exports from Hawaii, and the return business involved. The value of the traffic across the isthmus grew from 11,000,000 dollars to about 75,000,000 dollars. The cost of the new railway and docks, was borne by the Mexican Government. The distance from New York to San Francisco, via Tehuantepec, is 1000 nautical miles less than that via Panama, and the difference in favour of Honolulu about the same. But as the railway involves transhipment, with a loss of several days in handling goods, this advantage will not

necessarily remain. Nevertheless it cannot be doubted that the Tehuantepec Railway will be a rival of the Canal to a certain extent.

As regards the South American Pacific (or Atlantic) coast, this is, at present, without means of communication by rail with North America. But it cannot be long before the railway systems of the two continents are connected. The long-proposed Pan-American railway must undoubtedly be built in the future. The Mexican railway system, which is in effect a prolongation of the United States railways, is already being connected with Guatemala; and thence southwards through Central America, to join the systems of Colombia, Ecuador, Peru, and Chile on the Pacific coast, and those of Brazil and Argentina is only a question of time. The links required to fill in the Pan-American railway form, in the aggregate, some 5000 miles of line, the cost of which would be by no means prohibitive. Such a railway would necessarily cross the Panama Canal by means of a swing bridge, or by a viaduct across the Culebra Cut. This line is one of the great railway enterprises remaining to be carried out.

A further transcontinental route in South America which may yet call for recognition,

is that via the Amazon to the base of the Peruvian Andes, and thence across those mountains by railway to the Pacific coast. The Amazon is one of the most remarkable fluvial systems in the world, as indeed it is the largest. The steamer from Europe reaches the coast of Brazil and penetrates 2500 miles into the interior of South America, via the Amazon, to within some 400 miles of the Pacific coast. So far no railway has been built to bridge the gap across the Andes, except that the famous Oroya line from Callao and Lima reaches the summit, and an extension thereby is being made to the headwaters of steam navigation on the Ucayali, a branch of the Amazon in Peru. The completion of this line will create an important route of travel across the broad portion of the South American continent, whose interior is at present little more than a wilderness. Upon this line of route lie Para, Manaos, and Iquitos, the last-named being Peru's eastern capital.

The existing or projected railways in North and South America may be expected therefore to offer a certain amount of coast-to-coast competition with the Panama Canal. It is, however, impossible to predict with any approach to certainty what the result will be, so varying are the factors to be taken into

consideration. It has generally been held, in the science of transport, that the creation of fresh means of communication does not necessarily detract from the business enjoyed by existing ones, but rather, by creating new business, greater opportunities and increased movement, adds to the assets of all. This axiom does not always hold good, but it is confidently expected that it will be affirmatively demonstrated in the case of the Canal.

There remains for consideration the matter of a possible rival canal in the Central American isthmus. It will be recollected that such was once threatened at Suez, and the possibilities in that respect of Central America are not yet exhausted. Whether, however, any other nation is ever likely to pretend to construct a waterway across the isthmus of Central America is very doubtful. The Nicaragua route is covered by a recent treaty between the United States and that country, giving the Americans the right to construct a waterway there.

In Colombia there is still a route which might serve for the construction of a waterway. This is the combination of the Atrato and San Juan rivers; the first of which discharges into the Caribbean Sea, and the second into the Pacific. Their head-

waters approach so near to each other that, according to a survey made early in the nineteenth century, a canal, cut across the water-parting 400 yards long, between the two rivers, would complete the link of navigable communication. This, however, would doubtless be of necessity for smaller vessels. It was announced by the Colombian Minister in London recently that offers had been received at Bogotá from the United States for a treaty to cover this zone for a canal, which was refused by Colombia. That republic desires that its outstanding questions with the United States should be subjected to arbitration at the Hague, but the United States refuse.

The building of a canal at Panama has caused the old project of a ship-railway, such as that once proposed for Tehuantepec by the American, Eads, to be forgotten. This project was one for carrying ships across the isthmus upon a quadruple track, from sea to sea, as an alternative to the heavy cost of a canal in that region. The highest point of the Tehuantepec water-parting is 735 feet, at the Chivela Pass, and the distance across 125 miles. The difficulties of a ship-railway to carry the enormous bulk of a modern vessel are doubtless very great, but there are no engineering impossibilities involved. To carry

ships across a broad track, either in cradles or floating in a vast tank or caisson might present serious problems, but the cost of such a structure would be doubtless far less than that of a canal, and possibly the plan might have been worthy of more serious consideration by modern engineers.

CHAPTER XIII

TOLLS, FORTIFICATIONS, AND STRATEGY

As has been already remarked, the United States Government did not enter upon the construction of the Panama Canal with the idea originally that the enterprise would prove a remunerative or dividend-paying one. Such ideals, however, are not likely to prevent a business-minded nation from making every effort to prevent financial loss, and to secure whatever profits may be possible. Whether the waterway can be made a paying institution, after the manner of the Suez Canal, remains to be seen. It is hoped and asserted by those in a position to judge, that no further burden will have to be imposed upon the American taxpayer in respect of the work.

The total cost of the Canal was finally estimated at the equivalent of nearly £75,000,000 sterling, and interest, and the annual cost of operating will amount to a large sum. To this must be added the

yearly 'rent' of £50,000 to be paid to the Republic of Panama. The Suez Canal cost only £19,000,000, the Manchester Ship Canal, £15,000,000, and the Kiel Canal £8,000,000. The Suez Canal, as before described, pays a good dividend upon its shares. The profits have been so considerable that the British Government alone, due to its large holding, receives now upwards of £1,000,000 sterling per annum in dividends. With such a return upon the capital invested, the Suez Canal management might reduce its tolls still further and yet pay its shareholders well.

Elaborate calculations have been made of the amount of toll-paying tonnage that may be expected to make use of the Panama Canal. It has been estimated that within a short time after the opening this traffic will reach 7,500,000 or 8,500,000 tons per annum, and such an amount was, in fact, the ascertained possible figure for 1910. During that year the traffic passing through Suez amounted to 16,500,000 net register tons, about double that calculated as available for Panama. A member of the Isthmian Canal Commission[1] showed, according to his figures, the existence of 5,000,000 tons of available traffic in 1899

[1] Professor Amory Johnson, one of the leading authorities upon the Canal.

for Panama, which increased in the 11 years to 1910 by 66½ per cent., or at the rate of 59 per cent. per decade. Given a constant rate of increase in the same proportion to the year 1915, the traffic using the Canal at that date would be 10,500,000 tons per annum. It was held that the assumed increase of 59 per cent. per decade in the tonnage of available Panama traffic was conservative; that a study of the growth of the commerce of the world as a whole, and of the trade of different sections of the world with each other, warranted the figure.

The trade of the United States with countries other than European increased in tonnage 67·5 per cent during the decade ended in 1910; the trade of the Atlantic-Gulf seaboard of the United States with Pacific countries increased 63 per cent.; and the traffic of the Suez Canal, 70¼ per cent. above the large figures which it had attained in 1900. More than 60 per cent. increase per decade for the Panama Canal is, it is held by these authorities, to be expected; but should the growth only reach that figure, between 1915 and 1925, the traffic would reach 17,000,000 net tons register in the last-named year. Large as such a figure might seem, it would be small in comparison with the increased Suez traffic by that date; as under that

calculation Suez would have reached a total greater than 20,000,000 tons in 1915, and correspondingly greater in 1925.

Such are the calculations arrived at by American experts, but it remains to be seen how far actual circumstances will bear them out. The figure of 8,500,000 tons, calculated as being available at once, would leave a deficit on payments and expenses of operation. It has been argued by some authorities,[1] with a considerable show of reason, that an entirely free Canal would be an advantage to the United States; greatly increasing the demand for American products, and so benefiting the republic far more than the sum obtained by the receipt of tolls, which would amount in effect to a tax on American trade. It is further argued that even under such a system, the American transcontinental railways would benefit by the more rapid development of the Pacific coast and western American regions consequent upon a free Canal. Thus it is seen how conflicting are the opinions upon the subject.

As the time approached for fixing the important subject of the amount and range of the tolls to be charged upon vessels using the Canal, it became evident that the business

[1] The directors of the Pan-American Union, the Hon. John Barret, especially.

instincts of the United States were fully at work. 'Discrimination' in favour of American coastwise shipping was to be a feature of the American possession of the waterway. This alleged discrimination in the matter of Canal tolls in favour of the United States became crystallised in the Panama Canal Bill, brought into the United States Congress at the close of 1912, and it aroused very strong opposition in Great Britain. It was bluntly averred in Britain and by other maritime nations that the Bill involved a breach of faith and an infraction of the Hay-Pauncefote treaty.

In this treaty, as elsewhere quoted, it was set forth that 'the Canal shall be free and open to the vessels of commerce and war of all nations on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or subjects, in respect to the conditions or charges of traffic.' In spite of this very plain provision, the American Government approved the Bill discriminating in favour of American coastwise vessels, whereby these vessels were exempt from tolls. As shown elsewhere, the term 'coastwise' covered a very wide field, and included practically the larger part of the American mercantile marine.

A strong protest to the measure was

immediately made by the British Government. The Foreign Office put it plainly to the Washington Government that this was a direct contravention of the Hay-Pauncefote treaty. Various communications passed between the two Governments. The Americans endeavoured to justify their proposals. In October, 1911, President Taft had stated that 'if it were adjudged discrimination against other countries to favour American coastwise vessels, there was nothing to prevent voting back to coastwise vessels the tolls they would be required to pay.' This statement, again brought forward, was regarded by the British Press, and even by a strong American party, as an ingenious attempt at circumventing the question. First to collect and then to pay back these tolls would be equivalent, it was urged, to exacting no tolls at all. The American Government then abandoned that attitude, and instead of seeing an obstacle in the treaty, as had before been admitted, to the remission of these tolls, took up the new position that the treaty did not bear upon the point.

There was, however, a very strong party in the United States which denounced these provisions of the Bill as unfair and even damaging to the honour and good faith of the United States. Among these was the Secretary

for War.[1] who vigorously opposed the discrimination in favour of American coastwise vessels using the Canal, and declared that 'the policy of Congress in that respect was bad and unnecessary, and that Congress in passing the Panama Canal Bill acted contrary to the advice of the War Department, and urged the revision of the law.'

An argument of President Taft in favour of the Bill was that, as coasting trade was confined by law to American shipping already, such discrimination could not prejudice foreign shipping; that foreigners could not lose trade which they never possessed. Also, that the policy of exempting the coastwise trade really involved the question of granting a Government subsidy for the purpose of encouraging trade in competition with the transcontinental railways. In the past those railways had received assistance from the Government, and in giving support to other means of transport the Government was acting in accordance with such a policy, not reversing it.

The transcontinental railways have long been accused of abusing the practical monopoly they enjoyed. The motto of one of these railways had always been 'All the traffic will bear,' as the people of California

[1] Mr Stimson, quoted by *The Times*.

recollect well. The provisions of the Bill were, it was stated, partly for the purpose of penalising any such monopoly, as the Inter-State Commerce Commission had shown that drastic measures were necessary to maintain the independence of the coastwise shipping.

The methods of transport trusts in the United States are well known. Where possible, ships owned by the railway companies are run, even at a loss, until rival companies whose income depends solely upon their steamers are driven out of business. The land rates can then be raised or controlled to the benefit of the railway company, thus creating a monopoly. These illegal operations had long taxed the power of the Government to circumvent them. The process of 'freezing out of business' a rival concern is a species of modern buccaneering that, in the United States, has been brought to a fine art by the trusts and other dishonest financial concerns; and is scarcely less discreditable than the depredations of the early buccaneers of the Spanish Main.

The American railway companies were naturally opposed to the Panama Canal Bill, and its provisions concerning them, which amended the Interstate Commerce Law, were regarded as the most drastic statute affecting railways ever passed by Congress. The Bill

enacted that, after July, 1914, 'it should be unlawful for any railway company or other common carrier to own, lease, operate, control, or have any interest whatsoever (by stock ownership or otherwise, either directly or indirectly, or by directors in common) in any common carrier by water, operated through the Panama Canal.' The policy of discrimination against railway-owned vessels would, it has been argued, act adversely against Canada also. Canadian railways have large sums invested in steamships.

The controversy over the Bill continued for some time, and became international in character. As before remarked, a strong party in the United States regarded the discrimination as unfair, and a portion of the American Press spoke bitterly about the lax sense of international honour of the Americans and the ease with which an international treaty could be broken. They rebuked the 'Anglophobe' senators of Congress, and others who professed to think that the matter was merely a 'domestic' concern affecting only the United States. The last proposal of Great Britain was to bring the matter to arbitration, but to this the American authorities did not consent. The President was greatly blamed for his attitude, both by a party at home and by the British and other foreign Press. At

this period Mr Taft's term expired, and a new President, Dr Woodrow Wilson, was elected, who, it appeared, had a stronger sense of the justice of the situation than his predecessor. The subject did not of course affect Great Britain alone, but France, Spain, Germany, Italy, and all maritime nations. It was hoped in Great Britain that the situation would be fairly and amicably adjusted, and President Wilson later announced his resolve that an equitable course would be followed.

In August, 1913, it was announced by the British Government that Britain would not give any official support to the great Panama Exhibition to be opened at San Francisco in 1915. A great outcry followed in a portion of the American Press, which regarded this announcement as retaliatory, following upon the American action in the matter of Canal dues. But the same announcement was made by Germany.

It was then plainly shown by the British Foreign Office that the attitude was not retaliatory (it might justifiably have been so), but that His Majesty's Government did not consider the great expense incurred—estimated at £250,000—would be justified by the commercial advantages to accrue. The American Press then saw their mistake in attributing retaliatory motives to Britain, which country

promised to send battleships to take part in the opening of the Canal in due course.

The matter of tolls and dues in the Panama Canal has, so far, been fixed by proclamation of the United States President, Mr Taft, made in November, 1912. This called for—First: on merchant vessels carrying passengers or cargo, one dollar and twenty cents per net vessel ton—each one hundred cubic feet—of actual earning capacity. Second: on vessels in ballast without passengers or cargo, forty per cent less than the rate of tolls for vessels with passengers or cargo. Third: upon naval vessels, other than transports, colliers, hospital ships, and supply ships, fifty cents per displacement ton. Fourth: upon army and navy transports, colliers, hospital ships, and supply ships, one dollar and twenty cents per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels. The rules for these measurements and all necessary regulations for carrying out the proclamation were to be prepared by the Secretary for War.

These tolls are very similar to the tolls prevailing at Suez, which, as before shown, were reduced in January, 1912, to 6·25 francs, equal to one dollar twenty cents per net ton for loaded vessels, with passenger tolls of ten

francs per adult, and half price for children. In view of the competition for some of the world's carrying trade, which it seems natural will be set up, the tolls on one canal must bear a more or less constant rate to those on the other. The principal competitive region is Pacific Asia, and part of the East Indies and Australasia, forming that belt on the earth's surface about equidistant from both waterways. This debatable ground lies entirely east of Singapore. West of it the traffic belongs naturally to the Suez route, and is not likely to be disturbed unless some very unforeseen circumstances arise. As regards western and eastern America, it is an interesting question how far the transcontinental railways will meet the Canal dues by cutting their own rates to meet the cost of water-carriage through Panama.

The Panama Canal as constructed and controlled by the United States is strongly fortified. This fortification, upon which an enormous sum of money has been spent by the American Government, aroused considerable criticism in Britain, Europe, Japan, and elsewhere, and was, in fact, regarded in part as a breach of faith. The spirit—and in the Clayton-Bulwer treaty the words—of the agreement between Great Britain and the United States was that the Canal should not

be fortified. The Hay-Pauncefote treaty laid it down that 'the Canal shall never be blockaded, nor shall any right of war be exercised, nor any act of hostility be committed within it.' Thus the neutralisation of the Canal was established thereby. In the Hay-Bunau-Varilla treaty between the United States and Panama, it was set forth that the Canal 'shall be neutral in perpetuity, and shall be opened in conformity with all the stipulations of the treaty of 1901, entered into by the Governments of the United States and Great Britain,' but adds that 'if it should become necessary at any time to employ armed forces for the safety or protection of the Canal . . . the United States shall have the right to use its police and its land and naval forces or to establish fortifications for these purposes.'

Apart from the matter of the alleged breach of faith by the United States in fortifiying the Canal the advisability of so doing has been gravely questioned by a considerable party in that country and elsewhere, although supported by an equally strong or stronger party of Americans. The fortification of the Canal gives the United States the power of closing the Canal to its own belligerent. The party opposing fortification maintain that the conditions prevailing at Suez should have

been upheld, the Suez Canal not being fortified; and that a general agreement of world-powers should establish the neutrality of the waterway, the interests of all such powers tending to maintain its neutrality and preservation. But the opponents of this, and public opinion generally in the United States, held that such a guarantee would be insufficient. The peculiar American spirit was aroused, which held it derogatory to rely upon anything but its own powers, even at the risk of incurring reflections upon its national actions. The Canal, then, instead of being entirely neutral, is not neutral as far as the United States is concerned.

The strategic value of the Canal to the United States, in doubling the capacity of the American fleet by giving direct access between the Atlantic and Pacific coasts, has been fully discussed by naval authorities. But it has also been shown that, from one point of view, the Canal may be a point of weakness.[1] The Canal will depend for its supplies on sea transport, and for its preservation on the sea power of the United States. Instead, therefore, of reducing the burden of naval armaments for that country, the necessity for defending the Canal might add thereto. It has been pointed out that the Canal will have

[1] *The Times*, Sept., 1912.

'all the disadvantages and none of the advantages of an island.' Any power that might desire to deal the United States a sudden blow in time of war, might attack the Canal successfully unless the fortifications were of the utmost strength. It is not only at the terminals that the Canal could be attacked, but by troops landed elsewhere and marching through the jungle on either side.

The argument has freely been advanced that the fortifying of the Canal has been a mistake. A Japanese admiral,[1] who visited the Canal in command of a squadron, remarked that such a course 'might invite attack.' For this remark, which was cabled to Europe and Washington, the admiral was censured by his Government. It is argued that, if the Canal is to be fortified at all, great cost must be involved in its upkeep, and that a permanent garrison and patrol of 20,000 troops are necessary, instead of the 8000 originally decided upon. Under any circumstances the American navy must be strong enough to retain command of the sea and of the Canal.

There is no feeling of jealousy on the part of Great Britain in the matter towards the United States, and Britain has practically acceded to the American fortification of the Canal. Little but benefit can result to Britain, it might be

[1] Admiral Yashiro.

said, from American domination of the Canal from a military point of view. From the idea of war between Britain and the United States the Anglo-Saxon mind shrinks as it does from the idea of murder or fratricide. But in the event of such a war the Atlantic and Pacific coasts of Canada would be cut off from each other by the closing of the Canal to a British or Canadian fleet.

Whatever the circumstances, the fortifying of the Canal has called to being war-ideas and war-talk among American citizens. It is now proclaimed that the coasts of the United States are more open to attack and more easily violated than those of any other nation. But this is a very doubtful statement. The United States, with or without the Canal, offers conditions against invasion which are practically impregnable. A country with nearly 100,000,000 intelligent citizens within its two coasts, with thousands of miles of railways, and animated by so strong a spirit of patriotism as are the Americans, could not be invaded; they are immune from successful attack by sea, or at least from any sustained attack. No European or Asiatic nation could pretend to transport an army overseas and obtain lodgment in the United States.

The republic has been greatly dowered by geography and circumstance. Also it has

acquired the respect of the world, and may yet earn its affection; and it is safe to say, if the American people are to be engaged in any future conflict with a foreign power, it would more likely be the result of some wrongful act of their own, rather than that of their belligerent. If, on the other hand, an attempted wrongful violation of the Monroe Doctrine, by an Asiatic or European power should lead the United States to declare war, such a war would have to be fought out in South or Central America, as a naval battle, and could scarcely affect the coasts of the United States. American writers have endeavoured to draw parallels between Britain's military control of the Suez Canal on one or more occasions, especially as concerned Egypt; but such is a different case. The position of Britain is a difficult international one, such as the United States has never known, nor is likely to know.

In the American military control of the Canal it might be said that appetite has come with eating. The idea has grown among the American people that they must prepare for some great world-struggle. The policy of the United States has always been to remain aloof from 'entanglements' abroad, which was wise, but probably difficult, for it can readily be argued that the conflicts of the

future, if such occur, may be the result of endeavouring to acquire or control foreign markets.

The United States has entered upon the policy of selling its products abroad, of entering into acute competition with other nations. It may be argued that any nation has the right to endeavour to do this, but, nevertheless, it undoubtedly becomes offensive. The future may show that commercial aggression is almost as offensive as territorial aggression. 'Spheres of influence' are being jealously guarded. The right to force their products upon one nation by another, or to acquire special concessions, may yet prove a source of conflict. It can be shown that commercialism at times becomes, among all nations, a form of modern oppression or 'buccaneering.'

Be it, however, as it may, American writers and statesmen show how strongly they are obsessed by the idea of war, in building and fortifying the Canal. To 'double the power of their fleet' by the rapid communication afforded between their two coasts, has been a popular cry. Who is likely to be the enemy? There is evidently a strong conviction that some enemy will arise. The growth of the appetite has now evolved the condition that, 'in time of war the Canal is

to be open to our fleet and closed to the fleet of the enemy.' Of course there is much of common sense in this, which it would be difficult to dispute. For the United States to build a canal at enormous cost, and then to keep engineers upon it to open and shut the gates for an enemy's ships would be an impossible condition. The only reply is that the Canal should have been international in its control, as was always intended. The violation of the principle may yet lead to difficult situations.

In connection with the American activity upon the Canal, the question has naturally arisen in the minds of the Latin-American neighbours of the United States as to what will be the future policy of that country as regards territorial aggrandisement. The Latin American republics have professed some uneasiness upon this score. In 1879 the message of President Hayes to Congress declared that the policy of the United States was for a canal under American control; that it would change the geographical relation between the Atlantic and Pacific coasts of the United States, and the relation between that country and the rest of the world, and would be 'virtually a part of the coast line of the United States.' Such a declaration may have been made as a figure of speech

without any sinister meaning, but it might easily afford some unrest to Mexico and the Central American republics, thus surrounded, as it were, by United States 'territory.'

The geographical claim of the United States to control the Canal can easily be exaggerated. The isthmian zone is not, in any sense, part of the 'American coast line.' The whole of Mexico and Central America intervene between the southern boundary of the United States and Panama—a territory 3000 miles long, measured upon the Pacific coast—and of an area of nearly 9,000,000 square miles, embodying seven independent republics, with a population of some 25,000,000. Extending or exaggerating such a point of view, it might also be said that the Suez Canal is part of the coast line of Russia. To shut off Canada or South America from Panama is like shutting off Russia or Africa from Suez.

The geographical and political conditions regarding the United States and its Latin-American neighbours are not generally well understood by the European public. At times otherwise well-informed writers give expression to remarkable views upon that part of the world. It seems not to be recollected that the Latin-American nations have rights to their independence and territory as strong as those of any other nation, and, above all, that

their internal disorders are, in general, the result of a short independent life. The Latin-American republics are scarcely a century and a quarter old. Brazil as a republic is only twenty-five years old. These communities must be accorded time to set their houses in order.

The possibility of American interference in or 'annexation' of Mexico has frequently been raised. But it is doubtful if the United States has any such idea before them. They could not govern the country, nor would they gain any advantage thereby, and a condition of race-hatred would be set up such as the world has rarely witnessed, not even in the destruction of Poland and the annexation of Alsace-Lorraine. It might be a task, too, involving enormous expense and bloodshed. The Mexicans are a high-spirited and martial race, and the United States, to dominate the country, would have to embark upon a war whose end could not be foretold. Probably American public opinion is too wise to enter upon such a conquest, and in reality the American spirit is averse from trespassing upon other nations, or entering upon unrighteous 'imperial' conquests.

But as regards the Republic of Panama it has already been freely predicted that, sooner or later, the Americans will extend

their dominion to the whole of the country. It has even been asserted that events are purposely being shaped by Americans to bring about such control. It is held that the people of Panama cannot and will not carry out efficient administration, or the commercial development of their country, that injustice and corruption are rampant, and the resources of the land wasted. The existing double regimen of American and Panama authority does not work smoothly.

What the future will show in this respect it is impossible to forecast, but few would be surprised if the whole of this small republic became an American colony. The Panamanians have no one to whom they could look for protection, or even sympathy. The attitude of European nations would possibly be one of aloofness; Colombia would possibly see in it a measure of 'poetic justice' or punishment on Panama, and an added proof of American 'perfidy.' The powerful South American nations, Brazil, Argentina, and Chile, whose naval armaments are not to be despised, would possibly protest, but it is doubtful if they would take action.

The whole strategy of the Panama Canal remains to be unfolded, but the future may always contain surprises. A cannon-shot may never be fired to resound through the

isthmian jungle; and, again, a fierce struggle for the mastery of the Pacific, between the forces of the Anglo-Americans and the yellow people of Asia, or war between some European naval power and the United States, might have its theatre there. It would be impossible to forecast what may yet happen in this respect in the present unsettled condition of mankind. Of late, much has been made of the interdependence of nations commercially, as a factor against war. It is asserted that nations will be prevented by financial considerations from fighting. But it is as easy to show that the wars of the future are likely to depend upon the conquest of commerce. Nations of congested manufacturing people require an outlet for their wares, and may fight to force their products on each other. Thus it may be argued—as set forth in the next chapter—that upon the true independence and self-supplying of nations social equilibrium may rest, rather than upon international commercial and banking operations,

CHAPTER XIV

COMMERCE AND FUTURE

A REMARKABLE feature of the economic situation surrounding the building of the Panama Canal is that of the position of the United States mercantile marine. Relatively speaking, the United States has no merchant marine, or at least for foreign service. During the debates in the United States Senate at the period when the building of the Canal was seriously under consideration, in 1908, this absence of a mercantile fleet bulked largely, and interesting facts were brought forward relative to the somewhat curious condition. It was further sarcastically asked for whom the United States was building the Canal; whether for the benefit of the country or for that of foreign nations.

At that period not a single steamship flying the Stars and Stripes plied between United States ports and those of South America—Brazil, Argentina, Peru, or Chile. The United States mails from the Atlantic ports for Brazil and Argentina are carried to

Europe and thence to these South American ports, and passengers similarly travel by that route. Thus, in effect, New York, although geographically 870 miles nearer those countries was, in actuality, 8000 miles farther away.

As regarded the Pacific coast, the steamers of the Oceanic Line which formerly sailed to Australia from San Francisco were laid up in the harbour of the last-named port, unable to make the service pay, notwithstanding that the line was subsidised by the United States Government for carrying the mails. From Puget Sound, however, there were three American steamers sailing regularly to Japan and China, and at times to the Philippines. In fact, with small exception, and excluding certain coasting trade, the American merchant marine, whose flag was formerly seen in almost every port, had practically ceased to exist.

The internal shipping commerce of the United States is enormous; the tonnage of vessels cleared between American ports on the Great Lakes alone reaching, in 1908, more than 103,000,000 net tons, with 81,000,000 tons of freight. The freight through the Sault Ste. Marie, or 'Soo' Canal, connecting Lakes Superior and Huron, reached in that year (exclusive of Canadian freight) nearly 58,000,000 tons, with a value of 600,000,000 dollars, in comparison with which the volume

of traffic in the Suez Canal was small. But vast also as is the American foreign trade, American foreign shipping has not developed again since its early prosperous days.

This lack of a merchant marine by the United States obeys national enactments and certain economic laws. Ships which carry American mails, and are subsidised therefor, were required to be American-built, and manned by Americans; and the diet of the sailors on board was prescribed by law. The wages paid to American seamen have been kept up by the labour unions, and are far above those obtaining on the ships of other nations. The result is that the cost of operating American vessels is double that of European vessels, and, across the Pacific, double that of Japanese vessels. The operation of American steamers is, therefore, at a great 'disadvantage' in comparison with European or Japanese steamers, due partly to better conditions being insisted upon for the men on board.

Under these circumstances it is evident that, notwithstanding the geographical gain to the United States, over vast regions, in the construction of the Panama Canal, economic reasons, as at present obtaining, are somewhat adverse to American shipping. It has even been asserted in the United States that the main

benefit of the Canal, which is built with American money, will fall to its European and Japanese trade rivals, by reason of the condition of their merchant services. Further, vessels, in order to obtain American registry, are required by law to be built in American yards. But these yards cannot compete with British yards either in the cost or the durability of vessels, and it remains to be seen if the stimulus of the Canal will modify this condition. There was a time prior to 1850, when these conditions were reversed, and English shipyards could not compete with the 'clipper-built' American ships, and British trade suffered accordingly.

The question raised frequently as to what benefit the United States is to gain commercially by the Canal from one point of view is to the credit of that nation, in that it should have persevered in its resolution to build the Canal in the face of such criticism. It has further been replied to the above-discussed matter, that it is less in carrying trade than in increased commerce that the United States is to benefit industrially. It has also been asked, why the United States has not rather sought to increase its trade with the eastern states of South America, which are unaffected by the Canal, such as Brazil and Argentina. In 1908, it was computed that

there were 3000 European steamships entering and clearing at the ports of Rio de Janeiro and Buenos Ayres yearly, but none with the American flag. At the present time those figures have increased. The foreign trade of the Argentine Republic is very considerable. With between six and seven millions of a population, Argentina carries on a foreign trade approaching £150,000,000 sterling per annum, which is far greater than that of China, with its 400,000,000 inhabitants. Similarly with Japanese trade the question may be raised, as the foreign trade of that country is small in comparison with Argentina. Brazil has a foreign trade whose value approaches £125,000,000 sterling per annum, but the United States enjoys a relatively small portion of this.

The American commercial designs on the East are nevertheless perhaps more marked than elsewhere. In China, Japan, and elsewhere, there appeared to be for United States producers an insatiable market where their surplus merchandise and agricultural products could be placed, and the Panama Canal would largely neutralise the advantages previously enjoyed by their European trade rivals. It is true that North American exports to these countries have increased considerably, but it cannot be said

that the nature of the exports to Japan is altogether satisfactory, consisting as they do in raw materials and industrial machinery mainly—that is, elements which enable the cheap labour of Japan to compete with American manufacturers. The preponderance of British trade with South America, especially Brazil and Argentina, is naturally due largely to the large amount of British capital invested there. This reaches nearly £1,000,000,000 sterling in South America.

The foreign trade of the Pacific coast countries of South America is not at present very considerable, and how much it is likely to augment depends upon the availability of the soil for increased products. The western littoral of South America—Colombia, Ecuador, Peru, Chile, which has its natural outlet to the Pacific, is relatively small. The coast is paralleled by the enormous mountain chain of the Andes, which leaves only a strip or zone of territory, averaging less than 100 miles wide, but 4000 miles in length, the vast interior of the continent sloping naturally towards the Atlantic, with the extensive fluvial systems of the Amazon, Orinoco, and River Plate as its means of communication. So formidable is this Andean barrier that, so far, a bare half-dozen railways in 4000 miles of territory have surmounted it, only one of

which is transcontinental—that from Buenos Ayres to Valparaiso.

The coast strip or Pacific littoral, moreover, is very largely stark and arid, throughout the whole of Peru and northern Chile. More than half this region, as far as can be seen at present, is incapable of cultivation owing to the absence of rainfall. It is further a question if the region is not suffering from a slow change of climate to even further aridity owing to the decrease of rainfall in the mountains and the shrinkage of the Andean glaciers. The principal products of the coast are, in Peru, sugar and cotton, grown under artificial irrigation for home consumption and export. Of manufactures there are none for export, except Panama hats, and the same holds good for the neighbouring countries. Chocolate is exported from Ecuador, and other food products from the Peruvian interior in small quantities. Sugar and cotton production are important. The minerals of Peru afford an important means of industry, but are relatively small at present, although capable of much development. Coal and copper are both plentiful in the Andes, but there is a lack of railways to convey them to the coast, except as regards the district served by the Oroya line, and some other railways.

It is doubtful if the great export of Chile, the nitrate, would be brought to Europe by means of the Panama Canal. The field is too far to the south for much advantage to be secured over the Cape Horn route, and the nitrate, moreover, is mainly carried in sailing vessels, round the Horn, time being no object. The nitrate fields lie in the deserts of Tarapaca and Atacama, from about 20° to 25° south, and are shipped at Iquique and neighbouring ports. The value of the nitrate export for 1911 was 250,000,000 gold pesos—the peso being equal to 1s. 6d.—and it formed three-quarters of the total Chilean trade, and yielded nearly three-quarters of the national revenue by its export dues. The budget estimate of Chilean nitrate was in 1913 for an export of 57,000,000 quintals.

The nitrate fields are by no means inexhaustible. Calculations have been made, varying largely with the amount of optimism and the extent of the methods of survey employed, of a life for the deposits of 40 to 100 years, with extremes of 300 years. This is altogether problematical, however. The nitrate region, except for the industry, is an absolute desert, the nitrate existing because of the absence of rainfall. Nitrate, as has been said, is exported generally in sailing ships,

but the Canal will be of little service to vessels of that class. The bay and approaches of Panama are almost entirely calm, the absence of wind being remarkable, and towing through the Canal for vessels without steam would be necessary. Yet it is possible that in the future, nitrate may be more largely shipped in steamers via the Canal, and what may yet be determined in this respect cannot be definitely forecasted.

The matter of imports and exports from the Pacific coast of South America would appear to have been much exaggerated in some computations. The method employed has been to take all the entrances and clearances at ports, but when such traffic is effected by a few steamers passing up and down the coast constantly, such a method is erroneous, as the figures are enumerated several times over. Much is to be hoped, however, of the expansion of industry on the coast. The regions of Spanish America, and especially those of the Spanish Main and the Pacific coast, are of much interest.

Also there are many curious and valuable products brought down to those tropical and sub-tropical seaports, and many opportunities for profitable trafficking therein. There are cocoanuts from Central America and the coast of Mexico, pearls from the whole length of the

Pacific coast of the three Americas, and many kinds of plants and fruits, rare metals, gold, silver, and cinnabar, growing supplies of copper from Peru, and bars of lead ore—the half-exploited wealth of the great Andes. There are desert and mountain regions in their thousands of miles of almost untravelled wilderness, possessing their own peculiar beauty and utility, and perhaps holding surprises in their native resources. The people, the interesting and sensitive Spanish-Americans, welcome the foreigner. There is much of unique interest and beauty on those remote shores, for the traveller, the student, the archaeologist, and the trader.[1]

The possibilities of the Canal are connected with developments in other fields. A great system of canalisation of United States waterways is projected for the future, such as may assist American commercial developments in connection with the Canal. The vast interior of the United States will be rendered more acessible to the sea by improvements in the Mississippi and its tributaries, so that, with the Lake Michigan Canal and that of the Illinois River, steamers will be enabled to load at Chicago, Minneapolis, Duluth, Fort William, and other points direct for

[1] Fully set forth in the author's book: *The Republics of Central and South America.* Dent & Son, London, 1913.

Yokohama, Shanghai, Sydney, Calcutta, or Bombay. These matters are practicable, although they involve great work in perfecting or making interior waterways. The Mississippi Valley contains, perhaps, the region richest in natural resources of a diversified nature in the whole world. The development of extensive waterways in the interior of the North American continent is a matter of great future importance.

Corollary to the carrying of American products from that vast region, without transhipment, to the ports of the world, is that of the easier import of requisite commodities from the outside. For example, the nitrate of Chile, required for the refertilisation of the cotton-fields of the United States may find ready transit through the Canal. It is also proposed to import iron ore from Chile to the United States via Panama. The enormous Chilean iron ore deposits of El Tofo, near Coquimbo, which had formerly been worked by the French Creusot Company have been acquired by the Bethlehem Steel Company of Pennsylvania. It has been announced that the ores from this enormous deposit—the first cargo from which, received in Glasgow in 1912, was pronounced superior in quality to Spanish and Swedish ores—are to be shipped via the Canal in

steamers built for the purpose. It is to be recollected that from Chile to the Eastern American ports is a direct north and south voyage of comparative facility.

In considering the subject of competition between the Panama and Suez Canals, it is not necessarily the shortest distance that would influence a vessel in determining its choice of route. The question of obtaining cargo at intermediate ports, or of discharging such is naturally of importance, to which the facilities for coaling must be added. A vessel fully loaded for Japan from New York, for example, would naturally sail via Panama, but if a full freight were not obtainable for the return journey in the Japanese port the return via Suez might offer greater opportunities for picking up business on the way. Time is not always the main element in a voyage.

As regards fuel, the price or proximity of coal at the ports passed determines the route in many cases. Coal is bulky, and a steamer's stowage space is naturally encroached upon as little as possible for fuel, when money is to be earned in carrying goods. It is announced that the coal depots at Panama and Colon will be to some extent regulated by the authorities, and that the price of coal will be kept down. In this connection it is useful to note that there are large supplies of coal available in

the Andes of Colombia and Peru, as well as some deposits on the coast at tide-water in the last-named country.[1] This coal in the mountains exists in the form of extensive upturned seams, exposed at the surface, and is available for mining, but so far no exploitation on a commercial scale has been made. Conceivably this coal may, in the future, find its way to Panama as easily as coal from other sources. South America has generally been regarded as a country without native coal, but this view is erroneous. The Lota collieries in Chile are of much importance.

The tendency to use oil fuel on steamships is now apparent, but how far this will obtain it is impossible to predict. In South America there are extensive oil deposits, but these have been comparatively little exploited. Colombia, Venezuela, and Peru (also Argentina), possess oil wells, and in some cases British interests have obtained control of these. Trinidad is a valuable source of this fuel, and may be expected to furnish increased supplies, both for the British Navy and for mercantile purposes. How far the petroleum deposits of the world are likely to withstand the drain upon them brought about by the growing

[1] See the author's article in the *South American Encyclopædia*, 1913.

consumption of oil, remains to be seen. Both coal and oil are of course part of the world's mineral 'capital,' and are not replaceable.

The cost of coal and oil fuel on the isthmus is an important factor in connection with the navigation of the route. Plans have been made by the Canal authorities for depots for hundreds of thousands of tons of a high grade fuel at the terminii, primarily for the use of United States naval and other public vessels. For ordinary coal companies a low rental will be charged for good positions. Probably the large steamship companies from Europe and the United States will maintain their own coaling plants. A Californian oil company has constructed an eight-inch pipe line across the isthmus from Balboa, and other arrangements are being made for an efficient supply of coal and oil fuel. The cost of coal on the isthmus at the beginning of 1913 was 21s. per ton, and of fuel oil 4s. to 5s. 5d. per barrel.

A further point to be taken into consideration in the choice of Canal routes by vessels is that of prevailing winds. The headwind or fair wind is an element to be reckoned with even by steamers.

The total burden of the merchant and other ships of the world, except war vessels, is about 42,000,000 tons (1910), excluding vessels under 100 tons and the wood vessels of the Great

Lakes of America. Somewhat less than one-ninth of this is represented by sailing vessels, but in proportion of numbers these form 27 per cent. of the whole. Of the total of 42,000,000 tons Great Britain and her colonies own about 45⅓ per cent., or 19,000,000 tons. That the American tonnage increases is shown by the fact that the United States comes second with 5,000,000 tons, or 12 per cent. of the total. Of this, however, an aggregate of 2,118,000 tons was accounted for by the Great Lakes, and 2,800,000 tons (2899 ships) on the sea coasts, and 44,000 for the Philippines. This was followed by Germany with 4,500,000 or 10⅞ per cent., and Norway, France, Italy, Japan, Holland, Sweden, Russia, Austria-Hungary, Spain, and Denmark in the order named, with proportions downward from 4·8 per cent. to 1·8 per cent.

The world's tonnage has advanced rapidly, from 17,500,000 tons in 1873 to 42,000,000 in 1910, as above. German mercantile shipping has progressed rapidly, vessels being built both in Germany and the United Kingdom. The same may be said of Japanese shipping of the past few years. Some of the finest and fastest vessels now on service in the Pacific are Japanese liners built in Japan. In 1900 Japan possessed 503 steam vessels of 524,000 tons gross, which increased in 1908 to 861

vessels of 1,150,800 tons, or 120 per cent. in eight years.

Under the navigation laws of the United States all trade between American ports, however widely separated, such as New York and San Francisco, or from either of these to Honolulu or Manila, is declared to be 'coasting trade,' and vessels under a foreign flag are not permitted to engage therein. This trade has grown rapidly of recent years and employs a large part of the American mercantile marine, consisting largely in ocean-going vessels. The average percentage of United States commerce carried in United States ships was 90 per cent in 1820–30, which decreased to 15 per cent. in 1880–90, to 10·6 per cent. in 1907, and 9·5 per cent. in 1909.

There has been predicted as a result of the building of the Canal, a further decline in the number of sailing ships of the world. The tonnage of sailing vessels was calculated as being, in 1873, over 14,000,000 tons. It declined in 1888 to 11,700,000 tons, and in 1910 to 4,620,000 tons (of vessels of 100 tons and upwards). Sailing vessels carry certain kinds of freight, such as timber, coal, grain, sugar, nitrate, and so forth, mainly because full cargoes of such articles could be obtained at the port of departure, and time is not of great account in transit. Beautiful

iron-hulled, four-masted vessels made their way from Britain—and still do so—to the Pacific coasts of Western America, voyaging via Cape Horn, a noble race of ocean craft which depended upon wind and seamanship for their successful voyages. Forests of their masts might have been seen in the harbours of Callao or San Francisco, flying mainly the flag of Britain.

From Hawaii with sugar, also, came great five-masted schooners, beautiful in their symmetry. The 'wind-jammer' and the the 'limejuicer,' as such vessels have in the vernacular of the sea been dubbed, contained often very poor conditions of life for their crew; but they were picturesque, and from that point of view the oily and smoky steamer does not provide compensation.

Modern sailing ships have made rapid voyages from Europe to South America. From Iquique, in Chile, to the English Channel, the British ship *Maxwell*, of 1856 tons, sailed in 66 days, and the *Potosi* took 62 days on the reverse journey; the *Salamanca*, which sailed round the world in 153 sailing days, and others, from San Francisco to Queenstown in 88 days, are examples, as are the recorded German sailing ship voyages of 58 days from the English Channel to Valparaiso, and 69 to Adelaide. The famous 'tea-clippers' of the

middle of last century, both American and British, made fine runs from Foo Chow to London, and their history is a famous one. The record of 354 knots in 24 hours was made in 1869 by the *Sir Lancelot*. The economy in hands on board of sailing ships, due to steam labour-saving appliances, is very great. A 1000-ton East Indiaman in the middle of last century required a crew of 80, whilst a modern four-masted barque of 2500 tons has a total ship's company of only 33. Such craft, however, could not use the Panama Canal.

There are some considerations which may affect the matter of the world's carrying trade in the future, which must here be remarked. It is generally assumed that transport and commerce between nations is to continue to increase. At present the prosperity of a nation has been measured by the extent of its trade; its imports and exports, and any evidence of a halt in trade is regarded with apprehension. But the advanced economist knows that the prosperity of the masses does not depend upon these matters necessarily. The labourer in field, factory, or mine, even among the most advanced nations, cannot be said to receive more than a modicum of the wealth brought by trading, which wealth falls largely to the middleman.

Great benefits have been wrought for the world by foreign trading, and civilisation has penetrated to the darkest regions under its action. But evils have also been wrought. The decline of native industries has followed in some cases, and oppression of the servile and coloured races in others. It can be shown that the greatest measure of prosperity for a nation will be reached when such nation shall have become, as far as is physically possible, self-supplying and self-supporting, developing to the utmost both its own resources and its own manhood.[1] Great Britain, for example, is dependent far too greatly upon foreign food for its population, and upon foreign markets for its sale of manufactured goods, and indeed upon matters of buying and selling for its civilisation in general.

A much greater development at home, such as social reformers are now demanding, will lead to greater prosperity for the country as a whole, although doubtless the middleman or monopolist will suffer in the process. Furthermore, it is not too much to say that much of the world's transport is 'unnecessary.' That is to say articles are brought from one country to another which, under

[1] In his lecture before the Economic Section of the British Association in 1913, the author, under the heading of 'Human Geography and Industry Planning: A Coming World Science,' enlarged upon these points.

a more intensive development of home resources and capabilities, would be grown, manufactured, or consumed upon the spot.

Thus the growth of a scientific spirit of development, conservation and equilibrising of the resources of each and every country may lead to a diminution of the oversea carrying trade of the world. Examination will reveal a long list of staple materials and articles now brought to Britain which could be produced in the island itself; whilst the continued export of coal must be regarded as of doubtful economic wisdom. It is probable that, in the future, the intelligent masses of Britain will demand a 'protectionist' system both against unnecessary foreign imports and unwise exports.

Somewhat similar conditions concern the emigration of European peoples, who have to a large extent been driven abroad by unjust or feudal systems of land tenure at home; and in this respect Italy, Spain, Portugal, and Britain have been the greatest sinners. In Britain the popular demand is towards a change in land policy, due to growing enlightenment. Thus, a better balance of men and resources in their own countries may lead to less traffic, and consequently to stationary returns from inter-oceanic canals.

A further element to be considered is the increased cost of sea-borne traffic. Ocean carriage has been cheap partly by reason of the low pay and inferior regimen of the sailor's work and life. But inadequately-paid seamen will not continue to navigate vessels. It has been shown that the higher cost of carriage in American merchant vessels is due to the higher wages and better treatment of sailors, and this condition will be inevitable elsewhere in the future.

On the other hand, the undeveloped regions of the earth contain enormous possibilities for trade, if just benefits can be made to accrue to all classes concerned therein, and the scramble for wealth be regulated. Vast quantities of railway material and machinery are required in all backward lands, and many articles of food must, from geographical and climatic reasons, always be carried from one land to another. Undoubtedly also foreign travel for instruction and pleasure must increase, as the prosperity and enlightenment of the great masses of humanity increase.

For world-travellers, both tourists and others, the Panama Canal will open a new highway and be a new source of pleasure. At the present time whatever the attractions of America, North or South, there has always been something of a feeling that the traveller

had reached a species of *cul de sac*. Few would round the Horn or go through Magellan's Strait for pleasure on a voyage to Asia. It is in that region that the most mountainous waves in the world are encountered. As for the enormous stretches of coast from Cape Horn and Tierra del Fuego, stretching upwards through the 3000 miles of Chilean seaboard, the 1500 of Peru, and those of Ecuador and Colombia, and thence to Mexico, California, Oregon, and Alaska, few journey there except those bent on some special business. The West Indies, it is true, offered certain allurements, but they did not lie as part of a voyage in which, beyond them, the Old World could again be reached, except by doubling upon the track again. The possibility of having the Americas as an incident upon a world-circling voyage may now tempt many to visit those continents which before may have presented themselves as colourless and inhospitable. There is not the glow and romance, nor field for the study of humanity, in North and South America as exists in Asia; but if in time vessels as large and comfortable as the great transatlantic liners find it remunerative to undertake the circumnavigation of the world—which, as before remarked, will be possible now for the first time, north of the equator—the voyage would be one of vast

pleasure and instruction. A few days from Liverpool or New York by such a steamer would suffice to bring the traveller into the tropics, away from the cold north Atlantic, and growing science in ventilating and other apparatus would serve to temper the sweltering heat of Colon and the Caribbean Sea. Of course, having the Suez Canal, the advantage which a Panama Canal would have afforded in the time of Columbus as a 'road to Cathay' is far less. But to those travellers who already know those regions of the New World, who have travelled the stormy Gulf of Mexico and the hot Caribbean coasts, and journeyed port by port up the great Pacific coast of the three Americas always trammelled by the isthmus, there will be something of fascination in leaving the American Mediterranean behind, traversing a tropical lake, and emerging upon the Pacific, with prow turning thence towards the setting sun for Asia.

He would indeed be a thankless and pessimistic observer who would not conclude a study of this great work of human hands, the Panama Canal, upon a note of optimism. Mankind in the present stage of social development is very much like those Spanish adventurers, Vasco Nuñez de Balboa and his followers, who crossed the isthmus four hundred years ago, and stood upon a hill and

gazed at each other in perplexity on beholding an unexplored ocean before them, stretching away they knew not where.

Such a frame of mind dominates mankind to-day; such an unexplored region—a sociological region—lies before it. Yet out of social strife, constructive and destructive, we believe the way will be fashioned leading to that equilibrium for the human race and that fuller enjoyment of the world it inhabits, which it is legitimate to hope of the future. Let us therefore see in our mind's eye—those who may not see it in actuality—argosies passing through the great tropic waterway of the Panama Canal, laden with the kindly fruits of the earth, and fraught with matters of benefit to all the world.

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