opinion. "The change of calendar," says Prof. Newcomb, "met with much popular opposition, and it may hereafter be conceded that in this instance the common sense of the people was more nearly right than the wisdom of the learned. An additional complication was introduced into the reckoning of time without any other real object than that of making Easter come at the right time. As the end of the century approaches, the question of making 1900 a leap-year as usual, will no doubt be discussed, and it is possible that some concerted action may be taken on the part of leading nations looking to a return to the old mode of reckoning."[1] We are now several years nearer that time than when these words were written, but there is no proposition to return to the Julian reckoning, whilst it seems likely that Russia, which still observes it, will shortly adopt, either at once or by degrees, the Gregorian style, in which case all Christian nations will conform to its use. But it should never be forgotten that Cæsar's main object was to get rid of the previous Roman complication between a solar and a lunar year (endeavouring to keep them together by the insertion from time to time of an intercalary month), and substitute an entirely solar year with only an intercalary day every fourth year, making the length equal to its true amount within a few minutes.

But now comes the question, Is the so-called Gregorian year absolutely exact? Its length is unquestionably nearer that of the true typical year than the Julian year is. But a further modification is necessary if we really desire to make the date of the year correspond with the seasons for all time. The Gregorian rule amounts in fact to considering the year to contain 365·24250 days, whereas the typical year really consists of 365·24220 days, the difference being 0·00030 day, and the Gregorian year is too long by that amount. It in fact drops a leap-year not quite often enough, and a better rule would have been to drop one at the end of each successive period of 128 years. M. Auric has therefore recently suggested in the *Comptes rendus* of the French Academy a modification of the Gregorian rule, which would render it almost absolutely accurate, but which this generation need not, and in fact cannot, decide upon adopting. In 3200 years there are twenty-five periods of 128 years, so that there should be twenty-five omissions of leap-years. But by the Gregorian rule, only twenty-four leap-years are dropped in that interval, or one too few. His proposition then is to make an additional drop or omission of a leap-year in the year 3200 (which would, as the Gregorian rule now stands, be a leap-year), and at every succeeding period of 3200 years, A.D. 6400, 9600, being *not* leap-years. Strictly speaking, however, as the Gregorian calendar was arranged to start from A.D. 325, the first of these periods should expire more than three centuries later than A.D. 3200, and as A.D. 3500 will not be a leap-year by the Gregorian rule of dropping all divisible by 100 without remainder unless also divisible by 400, the nearest way to carry this proposal out practically would be to enact that A.D. 3600 should be an exception and not a leap-year; M. Auric's rule being afterwards applied at intervals of 3200 years, so that A.D. 6800 and A.D. 10000 would not be leap-years, although the Gregorian rule would make them so.

The present writer ventures to propound his own view that this same object would be carried out more straightforwardly by the natural course of dropping a leap-year at the end of each period of 128 years as it was completed, making unnecessary the Gregorian complication of an exception of an exception (*i.e.* the usual leap-year) now proposed to be increased by an exception of an exception of an exception. How exact this one exception would make the calendar (and M. Auric's suggestion would do precisely the same thing in a more roundabout way) may easily be shown. By dropping a leap-year (which usually occurs every fourth year) at the end of 128 years, we obtain in that period ninety-seven common years of 365 days, and thirty-one bissextile years of 366 days, or 46,751 days in all. Dividing this by 128, it is seen that this is equivalent to making each year contain 365·24219 days, the true length of the tropical year being (as above stated) 365·24220 days. It is agreed on all hands that 1900 is not to be a leap-year; and the effect of acting on this proposal would be that the next omission of a leap-year after that date would be in A.D. 2028.

W. T. LYNN.

[1] What Prof. Newcomb means here is making the vernal equinox which the paschal full moon followed, fall on the same date as it did at the time of the Nicæan council.

THE NICARAGUA CANAL.[1]

THE author of this book, though originally an engineer by profession, has become a traveller, a newspaper correspondent in Africa, the Far East, and Central America, and a writer about Eastern countries and problems. The book, accordingly, somewhat naturally reflects the two-fold experiences of the writer. Nicaragua is regarded, on the one hand, as the probable site of a gigantic engineering undertaking for connecting the Atlantic and Pacific, rivalling in commercial importance the Suez Canal; and the feasibility and prospects of the proposed canal are considered from an engineering standpoint, in combination with its commercial and political aspects, which cannot be disassociated from the more purely engineering problems involved. On the other hand, Nicaragua is described, in four chapters in the middle of the book, from the traveller's point of view; and details are given of the manners and customs of the population, the means of communication and resources of the country, with descriptions of the principal towns and other matters of interest noticed in the author's tour through the country. This portion of the book will possess attractions for readers of books of travel; but it appears to have been introduced rather with the object of recording the facts casually collected by the author, than as having any special bearing on the important problem of interoceanic communication. The main object of the book is unquestionably the Nicaragua Canal; and the Suez Canal has demonstrated that it is quite possible to construct a highway for navigation in a country devoid of natural resources, and that the physical conditions of the site selected, and the climate, are the main points which determine the feasibility of isthmian canals.

Several routes have been proposed for forming a water-way across the isthmus of Panama; but the only two which have been deemed capable of practical adoption are the line chosen for the Panama Canal, traversing a narrow portion of the isthmus between Colon and Panama, nearly following the course of the Panama Railway, and the more northerly Nicaragua route crossing a much wider part of the isthmus, in which, however, Lake Nicaragua provides a considerable length of natural water-way. The Paris Commission of 1879, presided over by M. de Lesseps, decided in favour of the Panama route in preference to all the others, including Nicaragua, mainly on the ground that it was essential that an interoceanic canal, with prospects of a very large traffic, should be an open water-way unimpeded by locks, like the Suez Canal; and Panama was the only route which could possibly fulfil this condition. When, however, owing to the treacherous nature of the soil under a tropical rainfall, the unhealthiness of the site when the surface vegetation was disturbed by the excavations, and the difficulties experienced in attempting to cope with the floods of the river Chagres, whose course frequently

[1] "The Key of the Pacific, the Nicaragua Canal." By A. R. Colquhoun. Pp. xiii + 443, with numerous illustrations, plans, and maps. (London: Archibald Constable and Co., 1895.)

crosses the line of the canal, it became imperative to introduce locks on the Panama Canal, in order to endeavour to complete the canal within a reasonable time and at a practicable cost, the special advantage of the Panama route disappeared. During the progress of the Panama Canal works, the Nicaragua scheme naturally remained

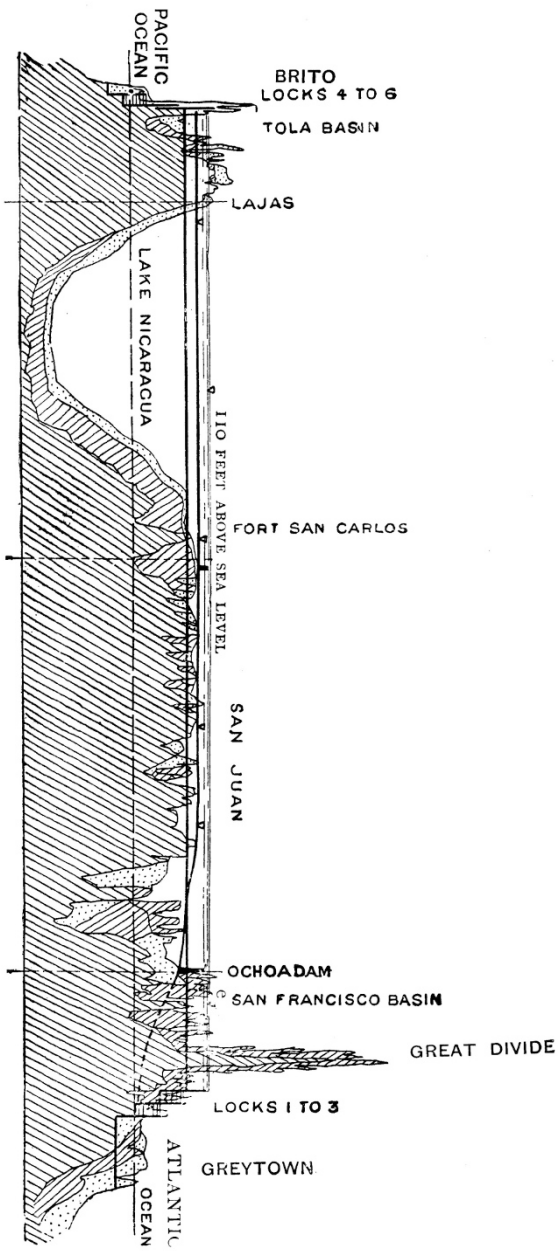

FIG. 1.—Nicaragua Canal (longitudinal section).

in abeyance; but when the works at Panama came to a standstill for want of funds in 1889, and discredit fell upon the promoters, interest was again aroused in the Nicaragua Canal as the only alternative method of connecting the Atlantic and Pacific. The two routes across the isthmus, starting from points 280 miles apart on the Atlantic side, present a remarkable contrast in their natural configuration. The Panama route, starting from Colon in the Bay of Limon on the Atlantic side, and terminating near Panama in the Bay of Panama on the Pacific coast, has a length of 46⅛ miles; and the ground rises on the Atlantic side with a fairly gentle slope to the central Culebra ridge, reaching a maximum elevation of about 317 feet above sea-level, and descends with a steeper slope to the Pacific. The canal, as originally designed, had to be formed in cutting throughout; and a considerable portion of the excavations had been accomplished along the 27 miles of lower ground at the two ends before the cessation of the works, but comparatively little progress had been made in cutting through the main central ridge, 19 miles in width. The introduction of five locks on each slope has very greatly reduced the amount of excavation for carrying the canal through the central high ground; but it has been estimated that nearly forty million cubic yards of excavation still remain to be effected, and that an expenditure of £36,000,000 is required for the completion of the canal with locks.

The Nicaragua Canal is designed to start from Greytown on the Atlantic side; and after traversing about twelve miles of low marshy land, it is to rise by three locks to its summit-level (Fig. 1). This summit-level is to consist of dammed-up waters of the Deseado, San Francisco, and San Juan rivers on the Atlantic slope, Lake Nicaragua, from which the San Juan River issues, and the Tola basin formed by damming-up the waters of the Tola and Grande rivers on the Pacific slope. The canal is to descend by three locks from the Tola basin to the harbour which is to be constructed at Brito, by two converging breakwaters, at the Pacific end of the canal. The peculiar feature of the Nicaragua Canal is the long summit-level provided, about 110 feet above mean sea-level, by damming-up the rivers on each slope, in addition to the natural water-way across the lake, thereby greatly diminishing the excavation for forming a canal with a total length of 169½ miles between the two oceans, and substituting free navigation along 142½ miles of the route, in place of the restricted navigation of a narrow canal (Fig. 2). In spite, however, of the engineering skill exhibited in adapting the design so as to take advantage of the special physical conditions of the site, two high ridges have to be pierced near the two extremities of the summit-level, known respectively as the Eastern and Western Divides, involving, in the case of the Eastern Divide, a maximum depth of cutting of 328 feet, equalling in depth the Culebra cutting originally contemplated for a tide-level canal at Panama, through strata apparently not very dissimilar to the Culebra cutting, and exposed, as in that case, to an exceptionally heavy tropical rainfall and a very unhealthy climate. In addition to these unusually deep and formidable cuttings, a considerable amount of dredging will be necessary along the upper part of the San Juan River, to procure the requisite depth of 28 feet, together with the removal of rock from its channel at its exit from the lake and across some rapids in its course. The formation of the canal across the low-lying land between Greytown and the locks on the eastern slope, presents no engineering difficulty; but the provision of a deep-water entrance between this portion of the canal and the Atlantic, and its maintenance, constitutes one of the most difficult problems of the undertaking. Greytown, the only place along that part of the coast, for a long distance, where deep water approaches the shore, is situated upon a lagoon which has gradually formed in front of the port, by the advance of the delta of the river San Juan under the influence of the waves raised by south-easterly winds; and it is proposed to carry a breakwater out from the shore into deep water to arrest the littoral drift, under the shelter of which an approach channel is to be dredged. A dam

composed of a mound of loose rubble stone, is designed to be formed across the San Juan River at Ochoa, below the confluence of the river San Carlos, 44½ miles from the lake, in order to raise the water-level of the river to that of the lake along this distance, amounting to an elevation of 56 feet at the site of the dam; but, considering that it is proposed to place this dam on the unstable sandy bed of the river, and that the floods of the river will pass over its crest, the design has not been given adequate solidity. The dam at La Flor, for the Tola basin on the Pacific coast, is to be given a masonry core; and dams will have to be formed for retaining the water in the San Francisco and Deseado valleys; and upon the security of these dams, and the provision for the discharge of the surplus water of the rivers, will depend the safety of the canal. Mr. Menocal, the engineer of the Nicaragua Canal, estimated the cost of the works originally at £13,000,000; but, after revising the estimates, and making allowance for contingencies, the capital has been fixed at £20,000,000; though on this point Mr. Colquhoun remarks that, "taking into consideration all the circumstances—especially the climate, its debilitating character generally, and the excessive rainfall on the eastern side, the volcanic question, the difficulties as regards labour—I am inclined to think that £30,000,000 in genuine expenditure on the work will be found nearer the mark than the present estimate."

The sites of the two rival schemes for piercing the isthmus of Panama, though differing greatly in their general configuration, are very similar in respect of unhealthiness and excessive rainfall on the Atlantic slope and the nature of the strata to be traversed by the excavations; whilst, though a greater height has been adopted for the summit-level for the Panama Canal with locks, necessitating a larger number of locks than for the Nicaragua Canal, the excavation for the Panama Canal has been reduced considerably below the amount required at Nicaragua, and the maximum depth of the Culebra cutting is now about 150 feet less than that of the cutting through the Eastern Divide. The Panama scheme has a greater length of restricted water-way; but this will be compensated for by the much shorter length of the canal, and by the proposed damming-up of the river Chagres, providing free navigation along one or two of the reaches, as well as controlling its floods. The chief difficulty in the construction of the Panama Canal, as now designed, consists in the control of the discharge of the torrential Chagres, which has, however, been greatly minimised by the introduction of locks; whilst not less difficult problems confront the promoters of the Nicaragua Canal, in ensuring the stability of the dams for raising the water-level, the control of the floods of the rivers impounded to form the water-way, and the formation and maintenance of a deep-water entrance through the advancing sands encumbering the approach to Greytown. Nicaragua, moreover, is much nearer the zone of volcanic disturbances than Panama; and severe shocks from this cause would be fatal to the stability of the dams. The estimated cost of completing the Panama Canal is indeed greater than the highest estimate quoted for the Nicaragua Canal, and more searching investigations of the site are in progress, which may possibly lead to an increase in the estimates; but, on the other hand, the recent very adverse report of the United States Commission on the Nicaragua Canal, both as regards construction and cost, shows that no reliance can be placed on the estimates hitherto presented, and that the designs of the dams and other important works will have to be entirely remodelled. A considerable amount of interesting information about the Nicaragua Canal, and its prospects and probable influence on trade, is given in the first five and two last chapters out of the fourteen contained in the book, the description of the project being naturally largely derived from the reports by Mr. Menocal, the originator of the scheme, often in the very words of the promoter. In comparing, however, the Nicaragua Canal with the Panama Canal, it is evident that Mr. Colquhoun adopts the part of an interested advocate instead of an impartial critic. Thus, after alluding to the main points of the Panama Canal and

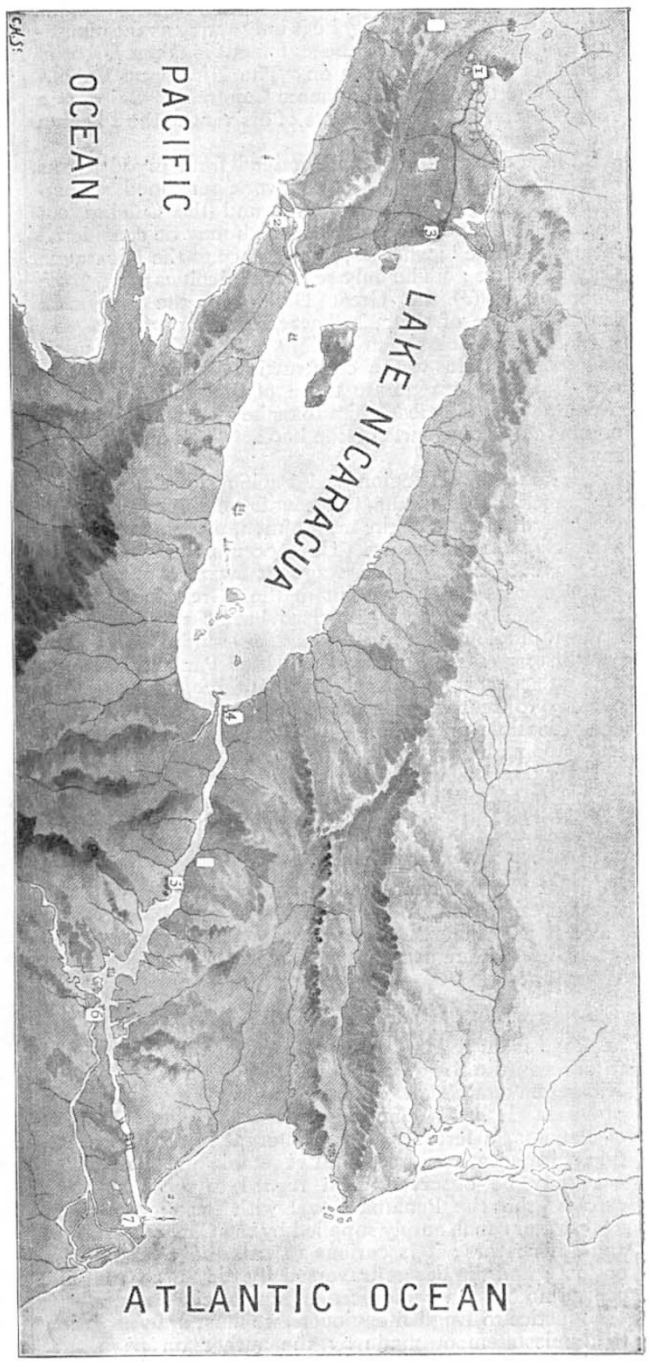

FIG. 2.—Nicaragua Canal.

Tehuantepec Ship Railway, he concludes the first chapter with the statement, that—

"The greatest obstacles met with in other localities are: (1) high elevations in the Cordillera separating the two oceans, requiring tunnelling; or (2) a high summit-

level requiring a large number of locks, for which an adequate water-supply is not obtainable; or (3) torrential streams whose control within economical limits defies the skill of the engineer."

"Nicaragua is free from all these obstacles."

It would naturally be supposed that Mr. Colquhoun was summing up the views he had arrived at after due deliberation; but in reality he is only acting as the mouthpiece of Mr. Menocal, for the statement is taken verbatim from this engineer's paper on "The Nicaragua Canal," read before the Water Commerce Congress of Chicago in 1893. Summing up the results of his visit to the Panama Canal, the author says:

"The general impression I gained from my visit was that a large amount of useful work remained accomplished. Still the Chagres river and the Culebra cut appeared to me to be obstacles which may be considered insurmountable"; whereas, in reference to the Nicaragua Canal, he says: "The only serious difficulties are (*a*) the Ochoa dam, (*b*) the Great Divide, (*c*) the Greytown Harbour, none of them, however, insurmountable."

In fact, Mr. Colquhoun exhibits a disposition to minimise the obstacles to the construction of the Nicaragua Canal, and to exaggerate those of the Panama Canal, which occasionally leads him to make contradictory statements in different parts of the book. Thus on p. 116, he says:

"While the lake region and Pacific slope are healthy and superior to Panama, the country embraced between Ochoa and Greytown, in my opinion, presents much the same climatic difficulties. Here occurs the dredging of the channel through the stagnant swamps of the San Juan delta, as well as the cut in the 'Great Divide' and the Deseado and San Francisco basins through dense tropical jungle with a rich (but rotten) surface soil. The past history of the Panama Canal and Panama Railway, with their enormous expenditures of life, makes it imperative to treat very seriously this question, and to take every possible precaution. The climates of both Colon and Panama have greatly improved since the canal days."

Later on, however, in contrasting the two schemes on page 142, he remarks:

"The advantages over Panama are these:—It is a fresh-water canal, with an admirable natural reservoir—the lake; it passes through a region offering prospects of great development, free from the marshy soil, the overpowering heat, and the unhealthy climate of Panama; there is no Chagres River problem, and the 'Divide' stands in a different category to that of the Culebra at Panama."

Again on page 317, he states:

"The Panama isthmus, in addition to being very unhealthy, is a region of floods with very poor local resources; the Suez Canal runs through a sandy desert. Nicaragua stands in marked contrast to both these projects. It has a climate immensely superior to that of Panama, a fertile soil, and internal intercommunication, with great resources both vegetable and mineral."

It may be observed, with regard to these last two extracts, that the Panama Canal with locks would be a fresh-water canal, amply supplied by the Chagres, Obispo, and other rivers; it is curious to call the Suez Canal a project; and the desert traversed by the Suez Canal has proved no bar to its unprecedented financial success.

In justice to English engineers, we must draw attention to a misstatement made by the author on page 138, where he says, with regard to the Suez Canal: "The report of other engineers was equally unfavourable." If Mr. Colquhoun had referred to the report he alludes to, he would have found that the Commission which reported was an international one, that the report was eminently favourable and formed the basis of the subsequent canal works, and that, in addition to the foreign members, three English engineers signed the report.

The Nicaragua Canal has naturally been preferred by the United States, as being nearer, and therefore more convenient for the trade of North America; and we agree with Mr. Colquhoun in considering that the simplest solution of the difficulty of connecting the Atlantic and Pacific Oceans, would be for the Government of the United States to construct the canal, which would be of incalculable benefit to the trade of that country. If, however, the United States is deterred from embarking upon this work by the very unfavourable report of the Government Commission, there appear to be no insuperable obstacles to the completion of the Panama Canal with locks, provided the necessary capital can be raised in France and elsewhere.

IN THE HEART OF A CONTINENT.[1]

THE small size of this record of ten years' travel is in keeping with the character of the author, as revealed in his pages. It is rare to meet a man so simple, brave, and kind-hearted as Captain Younghusband, and rarer still to find a book of travel so straightforward, concise, and modest as this. Many volumes have been written by travellers who have spent fewer months than Captain Younghusband has spent years in Central Asia, and without them it would perhaps have been difficult for us to estimate the magnitude of the difficulties, the overcoming of which the author so quietly relates. But this book differs from those by an entire absence of "padding," of hearsay statements, and of rash speculation. There are chapters indeed which are not purely descriptive, dealing in fact with the opinions formed and the thoughts suggested by ten years largely spent in the most remote and desolate regions of the earth. These thoughts and opinions are perhaps the most striking part of the book, showing in a remarkable manner the power of travel and the contemplation (rather than the study) of nature in educating an appreciative mind. To read the following extract from the five chapters of "Impressions of Travel," one would hardly suspect the author of being a young soldier:—

"No one, indeed, who has been alone with nature in her purest aspects, and seen her in so many different forms, can help pondering over her meanings, and though, in the strain and stress of travel, her deepest messages may not have reached my ear, now, in the after-calm, when I have all the varied scenes as vividly before me as on the day I saw them, and have, moreover, leisure to appreciate them and feel their fullest influence, I can realise something of her grandeur, the mighty scale on which she works, and the infinite beauty of all she does. These impressions, as I stand now at the close of my narrative, with the many scenes which the writing of it has brought back to my mind full before my eyes, crowd upon me, and I long to be able to record them as clearly as I feel them, for the benefit of those who have not had the leisure or the opportunity to visit the jealously-guarded regions of the earth, where nature reveals herself most clearly."

It is rare now-a-days to have the magnitude of the earth, the vastness of distances intervening between places, the month-long silence of desert and mountain forcibly brought before one, and it is startling to reflect how little the resources of modern applied science have done to facilitate journeys in really remote regions. Except for some articles of food and the means of defence, men must travel in Central Asia now just as they travelled in the days of Marco Polo, or even of Alexander.

A sketch of those journeys which have won for Captain Younghusband the gold medal of the Royal Geographical

[1] "The Heart of a Continent." A narrative of travels in Manchuria, across the Gobi Desert through the Himalayas, the Pamirs, and Chitral, 1884-1894. By Captain Frank E. Younghusband, C.I.E. (London: John Murray, 1896.)