John Ball

Notes of a Naturalist in South America

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PREFACE

A tour round the South American continent, which was completed in so short a time as five months, may not appear to deserve any special record; yet I am led to hope that this little book may serve to induce others to visit a region so abounding in sources of enjoyment and interest. There is no part of the world where, in the same short space of time, a traveller can view so many varied and impressive aspects of nature; while he whose attention is mainly given to the progress and development of the social condition of mankind will find in the condition of the numerous states of the continent, and the manners and habits of the many different races that inhabit it, abundant material to engage his attention and excite his interest.

Although, as the title implies, the aim of my journey was mainly directed to the new aspects of nature, organic and inorganic, which South America superabundantly presents to the stranger, I have not thought it without interest to give in these pages the impressions as to the social and political condition of the different regions which I visited, suggested to an unprejudiced visitor by the daily incidents of a traveller's life.

Those who may be tempted to undertake a tour in South America will find that by a judicious choice of route, according to the season selected for travelling, they may visit all the accessible parts of the continent with perfect ease, and with no more risk of injury to health, or of bodily discomfort, than they incur in a summer excursion in Europe. The chief precaution to be observed is to make the visit to Brazil fall in the cool and dry season, extending from mid-May to September. It may also be well to mention that, while the cost of passage and expenses on board, for a journey of about 18,400 miles by sea, somewhat exceeded £170, my expenses during about ten weeks on land, without any attempt at economy, did not exceed £100.

The reader may regard as superfluous the rather frequent references to the meteorology of the various parts of the continent which I was able to visit. But, if he will consider the importance of the two main elements – temperature and moisture – in regulating the development of organic life in past epochs, and the influence which they now exercise on the character of the human population, he will admit that a student of nature could not fail to make them the objects of frequent attention, the more especially as many erroneous impressions as to the climate of various parts of South America are still current, even among men of science.

I make no pretension to add anything of importance to our store of positive knowledge respecting the region described in this volume; I shall be content if it should be found that I have suggested trains of thought that may lead others to valuable results. I venture, indeed, to believe that the argument adduced in the sixth chapter, as to the great extent and importance of the ancient mountains of Brazil, approaches near to demonstration, and that the recognition of its validity will be found to throw fresh light on the history of organic life in that region of the globe.

In the Appendices to this volume two subjects of a somewhat technical character, not likely to interest the general reader, are separately discussed. With regard to both of them, my aim has been to show that the opinions now current amongst men of science do not rest upon adequate evidence, and that we need further knowledge of the phenomena, discoverable by observation, before we can safely arrive at positive conclusions.

In deference to the prejudices of English readers, which are unfortunately shared by many scientific writers, the ordinary British standards of measure and weight have been followed throughout the text, as well as the antiquated custom of denoting temperature by the scale of Fahrenheit's

thermometer. With regard to the metrical system of measures and weights, I am fully aware of its imperfections, and if the question were now raised for the first time I should advocate the adoption of some considerable modifications. But seeing that no other uniform system is in existence, and that the metrical system has been adopted by nearly all civilized nations, I cannot but regret that my countrymen should retain what is practically a barrier to the free interchange of thought with the rest of the world. The defects of the metrical system are mainly those of our decimal system of numeration, which owes its existence to the fact that the human hand possesses five fingers. If in some future stage of development our race should acquire a sixth finger to each hand, it may then also acquire a more convenient system of numeration, to which the scale of measures would naturally be adapted. In the mean time the advantages of a uniform system far outweigh its attendant defects.

The adherence to the Fahrenheit scale for the thermometer is even less defensible. It belongs to a primitive epoch of science, when a knowledge of the facts of physics was in a rudimentary stage, and its survival at the present day is a matter of marvel to the student of progress.

I should not conclude these prefatory words without expressing my obligations to many scientific friends whom I have from time to time consulted with advantage; and I must especially record my obligation to Mr. Robert Scott, F.R.S., who has on many occasions been my guide to the valuable materials available in the library of the Meteorological Office.

CHAPTER I

Voyage across the Atlantic – Barbadoes – Jamaica – Isthmus of Panama – Buenaventura, tropical forest – Guayaquil and the river Guayas – Payta – The rainless zone of Peru – Voyage to Callao.

A voyage across the Atlantic in a large ocean steamer is now as familiar and as little troublesome as the journey from London to Paris. It rarely offers any incident worth recounting, and yet, especially as a first experience, it supplies an abundant variety of sources of curiosity and interest. It is easy for a man to sit down at home and within the walls of his own study to find the requisite materials for investigating the still unsolved problems presented by the physics and meteorology of the ocean, or the evidence favourable or hostile to the important modern doctrine of the permanence of the great ocean valleys; but in point of fact very few men who stay at home do occupy themselves with these questions, and it is no slight privilege to feel drawn towards them by the hourly suggestions received during a sea-voyage. Nor is it possible to make light of the simpler pleasures caused by the satisfaction of mere curiosity, when that is linked by association with the pictures on which the fancy has worked from one's earliest childhood onward. The starting of a covey of flying-fish, the fringe of cocos palms rising against the horizon, the Southern Cross and the Magellanic clouds, the reversed apparent motion of the sun from right to left – none of them very marvellous as mere observed facts – are so many keys that unlock the closed-up recesses, the blue chambers of the memory, which the youthful imagination had peopled with shapes of beauty and wonder and mystery.

Some thrill of delightful anticipation was, I presume, felt by many of the passengers who went on board the royal mail steamer *Don* in Southampton Water on the 17th of March, 1882. Amid the usual waving of handkerchiefs from the friends who remained behind on board the tender, we glided seaward, and by four p.m. were going at half speed abreast of the Isle of Wight. The good ship had suffered severely during the preceding winter on her homeward passage from the West Indies, when the heavy seas which swept her upper deck had carried away the covering of her engine-room, stove in the chief officer's cabin, and severely injured her commander, Captain Woolward. On this occasion our voyage was easy and prosperous, and nothing occurred to test severely the careful seamanship of Captain Gillies, who had taken the temporary command.

ATLANTIC CYCLONES.

On the 19th the barometer, which, in spite of a gentle breeze from south-west, had stood as high as 30·40, fell about a quarter of an inch between sunrise and sunset; and in the night, on the only occasion during the entire voyage, remained for some hours below 30·00. A moderate breeze from the north brought with it a disproportionately heavy sea, and although there was no sensible pitching, the ship rolled so heavily as to send many of the passengers to solitary confinement in their berths. This continued throughout the 20th, afterwards styled Black Monday by the sufferers from sea-sickness, and we escaped into smoother water only on the evening of the following day. The discomfort which I felt from fancying that I had "lost my sea legs" was entirely relieved by fortunately coming across a distinguished naval officer, on his way to take a command on the West Indian station, who like myself was forced to hold on with both hands during the rolling of the ship.

It was clear that we had passed at no great distance from a cyclone in the North Atlantic – one of those disturbances whose visits are so often predicted from the western continent, but which so often fortunately lose their way or get dissipated before they approach our shores. It would seem that little progress has been made in forecasting the direction in which these great aërial eddies traverse the ocean, or the conditions under which they expend their force. It seems allowable to suppose that the most important of the causes influencing their direction depend upon the general movements of the great currents of the atmosphere; and that, as these are constantly modified by the changing position

of the earth in her orbit, the element of season is primarily to be considered. It being admitted that the origin of these disturbances is to be sought in the abnormal heating or cooling of some considerable portion of the earth's surface, it would seem that, in the case of the Atlantic, local causes can have little effect, unless we suppose that the heating of the surface of the Azores in summer, or the annual descent of icebergs from the polar seas, are adequate to influence the march of a travelling cyclone.

On the evening of the 20th the barometer had risen again to its former position, rather over 30·40 inches; the mean of the four following days was 30·55, and that of the entire run from Southampton to Barbadoes was 30·36. This fact of the continuance of high or low pressures at the sea-level at certain seasons in some parts of the world has scarcely been sufficiently noted in connection with the ordinary rules for the measurement of heights by means of the barometer. The tables supplied to travellers are all calculated on the assumption that the pressure at the sea-level is constant – the English tables fixing the amount at 30·00 inches of mercury, those calculated on the continent starting from a pressure of 760 millimetres, or about 29·921 inches. It is admitted that this mode of determining heights, when comparative observations at a known station are not available, is subject to serious unavoidable error. With regard, however, to mountains not remote from the sea-coast, it may be possible to lessen this inconvenience in many parts of the world by substituting for the assumed uniform pressure that higher or lower amount which is known to prevail at given seasons. Such a correction could not, of course, be made available in very variable climates, such as that of the British Islands, but might be applied in many parts of the broad zone lying within 40° of the equator.

ATLANTIC SPRING TEMPERATURE.

Soon after ten p.m. on the 21st we were abreast of the bright light which marks the harbour of St. Michael's, but, the night being dark, we saw very little of that or any other of the Azores group. The spring temperature of these islands is about the same as that of places in the same latitude in Portugal; but it appears that the cooling effect of the east and north-east winds prevailing at that season must in the mid-Atlantic extend even much farther south. With generally fair settled weather, the thermometer rose very slowly as we advanced towards the tropics. Between the 18th and 24th of March, in passing from 50° to 29° north latitude, the mean daily temperature rose only from about 55° to about 65° Fahr. – the thermometer never rising to 70°, nor falling below 52°. Notwithstanding the relatively low temperature, a few flying-fish were seen on the 24th – rare, it is said, outside the tropics so early in the year, though sometimes seen in summer as far north as the Azores.

On March 25th we, for the first time, became conscious of a decided though moderate change of climate. The thermometer at noon stood at 71°, and was not seen to fall below 70° until, some three weeks later, off the Peruvian coast, we met the cold antarctic current which plays so great a part in the meteorology of that region. We were now in the regular track of the north-east trade-wind, and my mind was somewhat exercised to account for the circumstance, said to be of usual occurrence, that the breeze increases in strength from sunrise during the day, and falls off, though it does not die away, towards nightfall. It is easy to understand the cause of this intermittence in breezes on shore, whether near the sea-coast or in the neighbourhood of mountain ranges, inasmuch as their direction and strength are determined by the unequal heating of the surface; but the trade-winds form a main part of the general system of aërial circulation over the surface of our planet, and, supposing the phenomenon to be of a normal character, the explanation is not quite simple. Regarding the trade-wind as a great current set up in the atmosphere, it is conceivable that the heating and consequent expansion which must occur as the sun acts upon it, tends to increase the rate of flow at the bottom of the aërial stream, while the cooling which ensues as the sun's heat is withdrawn, has the contrary effect.

On this and the next day or two my attention was called to the frequent recurrence of masses of yellow seaweed, sometimes in irregular patches, but more frequently arranged in regular bands, two or three yards in width, and extending in a straight line as far as the eye could reach. We were here at no great distance from the great sargassum fields of the Northern Atlantic, but I was unable

to satisfy myself that the species seen from the steamer was that which mainly forms the sargassum beds; and, whatever it might be, this arrangement in long straight strips seemed deserving of further inquiry. More flying-fish were now seen, and two or three small whales of the species called by seamen "black-fish" were sighted during this part of the voyage.

ENTERING THE TROPICS.

On the afternoon of the 26th we entered the tropics, and this and the following day were thoroughly enjoyable, but did not offer much of novelty. The colour of the sea was here of a much deeper and purer blue (rivalling that of the Mediterranean) than we had hitherto found it, while that of the sky was much paler. The light *cumuli* with ill-defined edges were such as we are used to in British summer weather; and, excepting that the interval of twilight was sensibly shorter, the sunsets were devoid of special interest. At this season the Southern Cross was above the horizon about nightfall, and was made out by the practised eyes of some of the officers; but, in truth, it remains a somewhat insignificant object when seen from the northern side of the equator, and to enjoy the full splendour of that stellar hemisphere one must reach high southern latitudes.

Although the thermometer never quite reached 80° Fahr. in the shade until we touched land, the weather on the 28th and 29th was hot and close, and few passengers kept up the wholesome practice of a constitutional walk on the long deck of the *Don*. Of the rain which constantly seemed impending very little fell.

ARRIVAL AT BARBADOES.

At daybreak on the morning of the 30th, in twelve days and seventeen hours, we completed the run of about 3340 nautical miles which separates Southampton from Barbadoes, and found ourselves in the roads of Bridgetown, about a mile from the shore. Being somewhat prepared, I was not altogether surprised to find that this first view of a tropical island forcibly reminded me of the last land I had beheld at home – the northern shores of the Isle of Wight. Long swelling hills, on which well-grown trees intervene between tracts of tillage, present much the same general outline, and at this distance the only marked difference was the intense dark-green colour of the large trees that embower the town and nearly conceal all but a few of the chief buildings. The appearance of things as the morning advanced quite confirmed the reputation of this small island as the most prosperous, and, in proportion to its extent, the most productive of the West Indian Islands. With an area not greater than that of the Isle of Wight, and a population of about sixty thousand whites and rather more than a hundred thousand negroes, the value of the exports and imports surpasses a million sterling under each head; and, besides this, it is the centre of a considerable transit trade with the other islands. Under local representative institutions, which have subsisted since the island was first occupied by the English early in the seventeenth century, the finances are flourishing, and the colonial government is free from debt. The average annual produce of sugar is reckoned at forty-four thousand hogsheads, but varies with the amount of rainfall. This averages from fifty-eight to fifty-nine inches annually, but any considerable deficiency, such as occurred in the year 1873, leads to a proportionate diminution in the sugar crop.

Among other tokens of civilization, the harbour police at Bridgetown appeared to be thoroughly efficient. As, about nine o'clock, we prepared to go ashore, we found on deck two privates – black men in plain uniform – who seemed to have no difficulty in keeping perfect order amid the crowd of boatmen that swarmed round the big ship. We had already learned the event of the hour – the fall of three inches of rain during the day and night preceding our arrival. This is more than usually falls during the entire month of March, and seemed to be welcomed by the entire population. On landing we encountered a good deal of greasy grey mud in the streets, but all was nearly dry when, after a short excursion, we returned in the afternoon. After a short stay in the town, where there was a little shopping to be done, and where some of my companions indulged in a second breakfast of fried flying-fish, I started with a pleasant party of fellow-travellers to see something of the island. It was arranged that, after a drive of six or seven miles, we should go to luncheon at the house of Mr. C – ,

the owner of a sugar-plantation, whose brother, Colonel C – , was one of our fellow-passengers. We enjoyed the benefit of the recent heavy rain in the comparative coolness of the air – the thermometer scarcely rose above 80° Fahr. in the shade – and in freedom from dust.

A small, low island, nearly every acre of which has been reduced to cultivation, cannot offer very much of picturesque beauty; nevertheless the first peep of the tropics did not fail to present abundant matter of interest. In this part of the world the dry season, now coming to an end, is the winter of vegetation, and, of course, there was not very much to be seen of the herbaceous flora; but the beauty of the trees and the rich hues of their foliage quite surpassed my anticipations. The majority of these are plants introduced either from the larger islands or from more distant tropical countries, that have been planted in the neighbourhood of houses.

One of the first that strikes a new-comer in the tropics is the mango tree, which, though introduced by man from its original home in tropical Asia, is now common throughout the hotter parts of America. Its widespreading branches, bearing dense tufts of large leathery leaves, make it as welcome for the sake of protection from the sun as for its fruit, which is a luxury that some persons never learn to appreciate. The cinnamon tree (*Canella alba*), common in most of the West Indian Islands, is another of the plants that serve for ornament and shade while ministering products useful to man. Of the smaller shade-trees, the pimento (probably *Pimenta acris*) was also conspicuous, and very many others which I failed to recognize, might be added to the new impressions of the first day in the tropics. One of the most curious is that known to the English residents as the sand-box tree, the *Hura crepitans* of botanists. It belongs to the *Euphorbiaceæ*, or Spurge family, but is strangely unlike any of the Old-World forms of that order. Here the fruit is in form rather like a small melon, of hard woody texture, divided into numerous – ten to twenty – cells. If, when taken from the tree, the top is sawn off and the seeds scooped out, no farther change occurs, and it may be, and often is, as the name implies, used as a sand-box. But if left until the seeds are mature, the whole capsule bursts open with a loud report, scattering the seeds to a distance. Thinking that a small young fruit, if dried very gradually, might escape this result, I carried one away, which, after my return to Europe, I placed in a small wooden box in my herbarium. Some nine months after it had been collected it must have exploded in my absence, for, unlocking the room one day, I found the box broken to pieces, and the valves of the fruit and the seeds scattered in all directions about the room.

POPULATION OF BARBADOES.

Next to the vegetable inhabitants, I was interested in the black population of the island. The first impression on finding one's self amid fellow-creatures so markedly different in physical characters is one of strangeness, and one is tempted to ask whether, after all, there can be any pith in the arguments once confidently urged to establish a specific difference between the negro and the white man. But this very quickly wears away, and a contrary impression arises. The second thought is that, considering what we know of the conditions under which the native races of Equatorial Africa have been developed during an unrecorded series of ages, and of the subsequent conditions during several generations of slavery, the surprising thing is that the differences should not be far greater than they are.

It would be very rash to draw positive conclusions from what could be seen in a visit of a few hours, but, undoubtedly, the general effect was pleasing, and tended to confirm the assertion that the difficult problem of converting a population of black slaves into useful members of a free community has been better solved in Barbadoes than in any other European colony. So far as the elementary wants are concerned, there was a complete absence of the painful suspicion so commonly felt as regards the poor in Europe and the East, that their food is either insufficient or unwholesome. With very few exceptions they all seemed sleek and well fed, and their clothing showed no symptoms of poverty. In the town their dress was generally neat, and most of the women made a display of bright colour in handkerchiefs and parasols. What struck me most was a general air of good humour and enjoyment. One may be misled in this respect by the facial characteristics of the black race, which, in the absence

of disturbing causes, readily turn to a smile or a grin. But, whether in the streets of Bridgetown or botanizing among the fields in the country, and using the few opportunities of speaking to the people, the same impression was retained.

Their manner in speaking to whites seemed to imply neither servility nor yet the independence which characterizes the Arab or the Moor. A latent sense of inferiority seemed to be combined with a complete absence of shyness or apprehension, as in children used to kind treatment, and not too carefully drilled. We happened to halt near a spot where there was a cluster of labourers' cabins, and a school well filled with small children. There had been a wedding in Bridgetown that morning, and as we halted two carriages passed, carrying the bridal party to some house in the country. All the inhabitants rushed out at once, and contended, young and old, in the most boisterous cheering. Perhaps this meant little more than the mere love of noise, as when boys cheer a passing railway train, but it argued, at least, the absence of any feeling of race animosity.

The houses of the labouring population, whether in town or country, are mere sheds, seemingly of the frailest materials, the walls of thin upright boards, and roofed with small imbricated wooden shingles, such as one sometimes sees in Tyrol; but there must be a very substantial framework, or they would be annually carried away by the August hurricanes. The interiors appeared to be fairly clean, and in a country where cold is unknown good houses are luxuries, not necessaries of life.

CAUSES OF PROSPERITY.

One need not go far to seek the explanation of the superior condition of Barbadoes as compared with the other West Indian Islands. Unlike these, there was here no waste land; every acre was occupied, and the emancipated negro could not follow the very natural but unfortunate instinct which elsewhere led him to squat in idleness, supporting life on a few bananas and other produce that cost but a few days' labour in the year. Apart from this, it is said that the Barbadoes, unlike the Jamaica, planters showed practical intelligence in at once recognizing the new conditions created by the Act of Emancipation, and, by offering fair wages and giving their personal influence and supervision, helping to convert the slave into an industrious freeman. Whatever poets may have fancied of the delights of lotus-eating, it seems to be true in the tropics, as well as in temperate climates, that there is more contentment and real enjoyment of life among people who are held to regular daily work – not excessive or exhausting – than among those who have little or nothing to do.

The house at which we were hospitably entertained, with no architectural pretensions, struck us as admirably suited to the climate. On the ground floor, several spacious and airy sitting-rooms opened on a broad verandah that ran round the building, and a number of fine trees close at hand, with the dense impervious foliage characteristic of the tropics, offered the alternative of sitting in the open air. One of the natural advantages of Barbadoes is the almost complete absence of noxious and venomous insects and reptiles. The frequency of poisonous snakes in some of the islands, especially Martinique and Sta. Lucia, must seriously interfere with the pleasures of a country life.

The voyage from Barbadoes to Jacmel, which occupied the greater part of three nights and two days, was highly enjoyable, but uneventful. With a temperature of about 80° in the shade, and a pleasant breeze from the north-east, life on deck was much more attractive than any occupation in the cabins, and nothing more laborious than reading an interesting book, such as Tschudi's "Travels in Peru," or at the utmost some brushing up of nearly forgotten Spanish, could be undertaken. In the early morning, the rising of the coveys of flying-fish as the steamer disturbed them from their rest on the surface, with their great silvery fins glancing in the level rays of the sun, was always an attractive sight. They certainly often change the direction of their flight as they momentarily touch the surface, but I could not satisfy myself whether this depended on a muscular effort of the animal, or merely on the angle at which it happened to strike the irregular surface of the little dancing waves that surrounded us.

JACMEL IN HAYTI.

About sunrise on the 2nd of April the anchor was let go, and we found ourselves in the harbour of Jacmel, the only port on the south side of the great island of Hayti. The Royal Mail steamers call here periodically to deliver letters and to receive a bag which, after due fumigation and such other incantations as are deemed proper, is delivered at the end of a long pole. The entire island being supposed to be constantly subject to zymotic diseases, especially small-pox which is the great scourge of the negro race, no further communication with the shore is permitted, and within less than two hours we were again under way. The hills surrounding the harbour are apparently covered with forest, the trees being of no great size, but of the most brilliant green; but I could detect no dwellings of a superior class such as Europeans would be sure to construct in picturesque and healthy spots near a seaport. As we ran for more than twenty miles very near the coast, I could at first detect here and there small patches of cleared ground with sheds or huts; but beyond the distance of a few miles these ceased, and no token of the presence of man was discernible.

Making large allowance for exaggeration, and having had the opportunity of correcting some loose reports by the more careful and accurate information afterwards received from a gentleman who resided for some time at Port au Prince as the representative of a European power, it is impossible for me to avoid the conclusion that, in the hands of its black possessors, this noble island has retrograded to a condition of savagery little, if at all, superior to that of the regions of tropical Africa whence they originally came.

There may be but slight foundation for the reports as to the revival of cannibal customs in the interior of the island; but it would seem that the sanguinary encounters so frequently recurring between the people of the rival republics between whom the island is divided, differ little in point of ferocity from those of Ashantee or Dahomey. The political institutions, caricatures of those of the United States, have produced in astonishing luxuriance all the abuses characteristic of different types of misgovernment, and the few men distinguished by superior intelligence and a desire for rational progress have sought in vain for support in efforts for reform. The condition of the two republics, Hayti and San Domingo, seems to be the *reductio ad absurdum* of the theories which ascribe to free institutions an inherent power of promoting human progress.

April 3 was a day to be long remembered. Barbadoes to Jamaica is as Champagne or Mecklenburg compared to Switzerland or Tyrol, and now for the first time the dream of tropical nature became a reality. At six p.m. we passed Port Royal, and about seven had cast anchor at Kingston. The first impression on landing here is unfavourable. The buildings are mean, the thoroughfares and side-paths out of repair, the people in the streets seem to have nothing to do and to be doing it, the general air that of listlessness and neglect. Altogether the place contrasts disadvantageously with the ports of Spanish America, to say nothing of our own colonies. But Kingston was not to detain us, and the overpowering attraction was towards the range of the Blue Mountains, on which my eyes had been fixed all the morning as we approached the shore. We were told that we must return to the ship at five o'clock, so that it was hopeless to attempt to reach even the middle zone of the mountains, and all that could be done with advantage was to engage a carriage to a place called Gordontown, in a valley which is the ordinary route to Newcastle and other places in the mountains. After a delay which to our impatience seemed unreasonable, I started in a tolerable carriage with W – , an old friend who was proceeding to Lima as commissioner from the Court of Chancery to receive evidence in an important pending lawsuit, and who, although not a naturalist, gave effective and valuable help on this and other subsequent occasions in the work of plant-collecting.

EXCURSION IN JAMAICA.

For a distance of four or five miles the land slopes very gently from the coast towards the roots of the hills. This tract is partly occupied by sugar-plantations; but our road lay for some time among small country houses, each surrounded by pleasure-ground or garden. As the dry season was not yet over, the country here looked parched; but I saw many trees and shrubs new to me, many of them laden with flowers, and found it hard to keep my resolution not to stop the carriage until we should

reach Gordontown. The excitement increased as we entered the valley, and the road began to wind up the slopes above the right bank of the torrent, where at every yard some new object came into view. It was near eleven a.m. when we reached the little inn, which, with four or five houses, make the station of Gordontown, where the carriage road ends, and horses are hired by those bound for Newcastle or other places in the hills. No time was to be lost, and we were speedily on our way to ramble up the valley, keeping as near as might be to the banks of the torrent.

The first effect upon one accustomed only to the vegetation of the temperate zone is simply bewildering. As I expressed it at the time, it seemed as if the inmates of the plant-houses at Kew had broken loose and run scrambling up the rocky hills that enclose the valley. These are of a red arenaceous rock, rough and broken, but affording ample hold for trees as well as smaller plants. The torrent at this season was shrunk to slender dimensions, but is never wholly dry; and I was somewhat surprised to find that on the steep slopes exposed to the full sunshine the vegetation was much less parched than one commonly finds it in summer in the Mediterranean region, and even to gather a good many ferns on exposed banks. It would appear that, even in the dry season, the air must here be nearly saturated with aqueous vapour, and that abundant dews must supply the needs of delicate plants. Not many species were in flower, but yet there was more than sufficient to occupy the short time available. *Malvaceæ* and *Convolvulaceæ* were the most prominent forms; but to a new-comer the most lively interest attaches to groups never before seen in a wild state, such as *Passiflora*– of which two species were found in flower – a first solitary representative of the great tropical American family of *Melastomaceæ*, or the gorgeous Amaryllid, *Hippeastrum equestre*, hiding in shady places by the stream.

VEGETATION OF GORDONTOWN.

Although Gordontown can scarcely be so much as a thousand feet above the sea-level, the climate is very sensibly cooler than that of Kingston. When we left the town the thermometer stood at 83° in the shade, while here at midday the sea-breeze felt positively cold, and I was glad to have with me an extra garment. A light luncheon of ham and eggs, with guava sweetmeat for dessert, was soon despatched; and, as I wished to halt at several spots on the way, we started about half-past two, laden with the spoils of the excursion, and reached the steamer before five o'clock. Great was my disgust to find that there was no intention of starting until nine a.m. the next morning, and this was changed to indignation when it came to be known that we had been deprived of the priceless pleasure of a trip to the mountains by the deliberate misstatement of the company's superintendent, who had arranged to embark on the following morning three hundred negroes going to work on the Panama Ship Canal.

A stranger can scarcely fail to observe a marked difference between the negro population of Jamaica and that of Barbadoes. In the larger island, while no way deficient in physical qualities, they appear decidedly inferior in intelligence, activity, and courtesy towards their white neighbours. It is said that the independent class, who live by cultivating small patches of land on which they have squatted, has of late years much improved, and that the increasing desire for purchasable comforts and luxuries has begun to develop habits of steady industry; but as regards the mass of the people who live by wages, there are many indications of a sullen dislike towards the descendants of their former masters which some trifling provocation may at any time inflame to a pitch of wild ferocity. Some who have lived in the island maintain that a general rising with a view to the massacre of the white population is not an impossible occurrence, and, however improbable it may appear, there is ample reason for constant vigilance on the part of those responsible for the government of the island. Such vigilance, it must be remembered, is quite as much requisite to prevent acts of real or apparent injustice towards the inferior race, as to repress the first beginnings of violence if some spark should fire the mine of suppressed hatred.

After a too short visit to this beautiful island, we were under way before ten a.m. on April 4th, and before midday the outline of the Blue Mountains of Jamaica was fast fading in the northern horizon. Throughout the greater part of the run from Kingston we encountered a moderately brisk

breeze, which gradually veered from south-east to south-west, and this, according to our experienced captain, commonly occurs at this season. It may be conjectured that the great mountain barrier extending on the south side of the Caribbean Sea through Venezuela and Colombia deflects the current of the north-east trade-wind until it finally flows in an exactly contrary direction. Whatever its origin may be, it might be supposed that the interference of a current from the south-west with the course of the regular trade-wind would give rise to storms of dangerous violence. These, however, rarely if ever occur during the spring months. It may be that, on the meeting of contrary currents of unequal temperature, the ordinary result is that the warmer current rises and flows over the cooler one without actual interference.

ISTHMUS OF PANAMA.

Before sunrise on the morning of the 6th we reached Colon, and, after a little inevitable delay, took leave of our excellent commander, and set foot on the American continent at a spot which seems destined to become familiar to the civilized world as the eastern termination of the Panama Ship Canal. People who love to paint in dark colours had done their best to make us uncomfortable as to the part of the journey between the arrival at Colon and the departure from Panama. The regular train crossing the isthmus starts very early from Colon, and we should be forced to remain during the greater part of the day breathing the deadly exhalations of that ill-famed port. In point of unhealthiness Panama is but little better than Colon, and as the weekly steamer of the Pacific Navigation Company bound southward would have departed one or two days before our arrival, we were sure to be detained for five or six days, equally trying to the health and temper. Fully believing these vaticinations to be much exaggerated, we had no opportunity of testing them. A free use of the telegraph on the morning of our arrival at Jamaica, and the courtesy of the officials of the various companies concerned, relieved us from all anxiety, and reduced our stay within the shortest possible limits. It was true that the regular train had been despatched before we could land, but a special engine was in readiness to convey us across the isthmus, and the agent for the Pacific mail steamer at Panama had detained the ship bound for Lima until the same evening in order to enable us to continue our voyage.

Since the commencement of the works connected with the canal, Colon must have undergone much improvement. The bronze statue of Columbus presented by the Empress Eugénie, which for many years had lain prostrate in the mud of the sea-beach, has been cleansed and placed upon a stone pedestal. A number of stores, frail structures of wooden planks, were arranged in an irregular street, and displayed a great variety of European goods. It was rather surprising to find the prices of sundry small articles purchased here extremely moderate. One might suppose that the only inducement that could lead people to trade in a spot of such evil repute would be the hope of exorbitant profits enabling them soon to retire from business.

Of the works connected with the Ship Canal little was to be seen from the railway cars. For its eastern termination the mouth of the Chagres river, which reaches the sea close to Colon, has been selected. I am not aware whether it is proposed to divert the course of that stream from the channel of the canal, but, to judge from the appearance of its banks and the extensive mangrove swamps on either side, it appears to bear down a great amount of fine alluvial mud, which, if discharged into the canal, must be a source of future difficulty. What chiefly struck the eye of the passing traveller was the broad band which had been cleared across the isthmus to mark the line of the future canal. It is fully a hundred metres in width, and seemingly carried in a nearly straight line through the forest and over the hills that lie on the western side near to Panama. This clearing does not appear a very serious undertaking, but in a region where the energy of vegetation is so marvellous, must have cost an immense amount of labour, and to keep the line open, if that be found expedient, will demand no small yearly expenditure. There is here, properly speaking, no dry season. The rains recur at frequent intervals throughout the year, and to keep back the ever-encroaching sea of vegetation the axe is in constant requisition.

PANAMA SHIP CANAL.

In the interest of the human race, it is impossible not to desire the success of the Ship Canal, but it must not be forgotten that the project is of a character so gigantic that all previous experience, such as that of the Suez Canal, fails to give a measure of the difficulties to be encountered, or of the outlay required to overcome them. Engineers may doubtless calculate with sufficient accuracy the number of millions of cubic yards of rock or earth that must be removed, and may estimate approximately the cost of labour and materials; but the obstacles due to the climate and physical conditions of this region are a formidable addition whose amount experience alone can fully determine. The only race combining physical strength with any moderate adaptation to the climate is apparently the African negro, and even with these the amount of sickness and mortality is said to be alarmingly great. The field from which negro labour can be recruited, though large, is by no means unlimited, and it is to be expected that the rate of wages must be considerably increased as time advances. The conditions of the problem have no doubt been carefully studied by the remarkable man to whom its existence is due, and by the able assistants whom he has consulted; but it may not be too rash to hazard the prediction that, apart from any international difficulties, its success may depend upon the more or less complete realization of two desiderata – first, the extensive application of labour-saving machinery, for which perhaps the heavy rainfall may supply the motive power; secondly, the possibility, by completely clearing the summits of some of the higher hills near the line, of establishing healthy sites whence workmen could be conveyed to the required points during the day and brought back before nightfall.

EQUATORIAL VEGETATION.

Nothing in our brief experience suggested the idea of an especially unhealthy region, and the feelings of a botanist at being whirled so rapidly through a land teeming with objects of curiosity and interest are better imagined than expressed. For more than half the distance the line is simply a trench cut through the forest, which is restrained from invading and burying the rails only by constant clearing on either side. The trees were not very large, but seemed to include a vast variety of forms. More striking were the masses of climbers, parasites, and epiphytes, to say nothing of the rich and strange herbaceous plants that fringed the edge of the forest. Our train, being express, gave but a single chance of distinguishing anything amid the crowd of passing objects – during a brief halt at a station about half-way across the isthmus, round which was a cluster of small houses or huts, inhabited by Indians. Their features were much less remote from the European type than I had expected – less remote, I thought, than those of many Asiatics of Mongol stock. Ten minutes on the verge of the surging mass of vegetation that surrounded us gave a tantalizing first peep at the flora of Equatorial America. Many forms hitherto seen only in herbaria or hot-houses – several *Melastomaceæ*, *Heliconia*, *Costus*, and the like – were hastily gathered; but the summons to return to the train speedily calmed the momentarily increasing excitement. Although the sky was almost completely free from clouds, and the sun very near the zenith, the heat was no way excessive. My thermometers had been stowed away in the hurry of leaving the steamer, but I do not believe that the shade temperature was higher than 84° Fahr. On the western side of the isthmus the land rises into hills some five or six hundred feet in height, and between these the railway winds to the summit level, thence descending rather rapidly towards Panama. What a crowd of associations are evoked by the first view of the Pacific! What trains of mental pictures have gathered round the records of the early voyagers, the adventurers, the scientific explorers! Strangely enough, the most vividly impressed on my memory was a rough illustration in a child's book, given to me on my seventh birthday, representing Vasco Nuñez, as, from the summit of the ridge of Darien, he, first of all western men, cast his wondering eyes over the boundless, till then unsuspected, ocean. He has climbed the steep shattered rocks, and, as he gains the crest of the ridge, has grasped a projecting fragment to steady himself on the edge of the dizzy declivity. Even now, after looking on the gently swelling hills, so completely forest-covered that without extensive clearing a distant view would be impossible, I find it hard to believe that that picture does not represent some portion of my actual past experience.

I do not know whether, in connection with the vivid recollection either of actual scenes or illustrations dating from early life, attention has been sufficiently called to the curious tricks which the brain not seldom performs in discharging its function of keeper of the records. In my experience it is common to find, on revisiting after many years a spot of which one believes one's self to have a vivid and accurate recollection, that the mental picture has undergone some curious changes. The materials of the scene are, so to say, all present, but their arrangement has been unaccountably altered. The torrent, the bridge, the house, the tree, the peak in the background, are all there, but they are not in their right places. The house has somehow got to the wrong side of the torrent, or the peak rises on the right of the tree instead of the left. A picture vividly retained in the mind is one that has been frequently recalled to memory. If at any time, when it has been long dormant, the actual recollection has become somewhat imperfect, the imagination fills up by an effort the incomplete portion. When next summoned by some train of association, the image present to the mind is no longer the original picture, but the altered version of it in the state in which it was left after being last retouched.

GRAND HOTEL OF PANAMA.

In about four hours from Colon we reached the Panama terminus, and found a large waggonette, or roofless omnibus, waiting to convey us to the Grand Hotel. A pair of small ragged horses, rushing at a canter down the steep slopes and scrambling up on the other side over the rough blocks that form the pavement, made our vehicle roll and jolt in a fashion that would have disquieted nervous passengers. It would be difficult to find elsewhere in the world a stranger assemblage than that to be found at the Grand Hotel of Panama. The ground floor, with several large rooms, is occupied day and night for eating, drinking, smoking, and loud discussion by the floating foreign population of the town. At the present time the engineers and other officials connected with the Ship Canal formed the predominant element; but, along with a sprinkling of many other nationalities, the most characteristic groups consisted of refugees from all the republics of Central and South America, who find substantial reasons for quitting their homes, and who resort to Panama as a sanctuary whence some new turn in the wheel of revolution may recall them to some position of distinction and profit.

We were fortunate in having in our company Mr. W – , a gentleman of Polish descent, to whose lively conversation we had owed much information and amusement during the voyage from Southampton. Now the owner of a large estate in Ecuador, he had long known this region, and appeared to be on terms of familiar acquaintance with all the strange visitors gathered in the saloons at Panama, from the ex-President of Peru to the negro head-waiter. The latter, as we learned, was not the least important member of the assemblage. In one of the numerous revolutions at Panama he had played a leading part, and had attained the rank of colonel. His party being then out of office, he had for the time returned to private life, but may possibly at the present day be again an important person in the state.

For the first time since leaving England the heat at Panama during the midday hours was felt to be oppressive, and we were content with a short stroll, which, to any one familiar with old Spain, offered little novelty. Unlike such mushroom spots as Colon, Panama has all the appearance of an old Spanish provincial town. It has suffered less from earthquakes than most of the places on the west coast, and a large proportion of the buildings, including a rather large cathedral, remain as they were built two or three centuries ago.

As the anchorage for large steamers is about three miles from the town, we had an early summons to go on board a small tender that lay alongside of a half-ruined wharf, but were then detained more than an hour, for no apparent reason other than as a tribute to the habits of the population of this region. The time was not wholly wasted, as even the least observant passengers were struck with admiration at the performances of a swarm of small birds, many hundreds in number, that seemed to have selected the space over the shallow water opposite the town for their evolutions. For more than half an hour they continued to whirl in long loops or nearly circular sweeps, with no other apparent motive than the pleasure of the exercise. Seen from a distance, the appearance was

that of a wreath; nearer at hand, the arrangement was seen to be constantly varying. Sometimes the birds were so close together that it seemed as if their wings must jostle; sometimes they were drawn out into long curves, looking silvery white when the sun fell upon their breasts, and of a darker tint at other incidences. Mr. W – asserted that the bird is a kind of snipe, but I have no doubt that it is a tern.

BIRDS IN PANAMA BAY.

At last the little tender glided from the wharf, and for the first time we gained a general view of the town, which has a full share of that element of picturesqueness which is so strangely associated with decay. The old ramparts fast crumbling away, here and there rent by earthquakes, and backed by time-stained buildings, would offer many a study to the painter. Sunset was at hand when we reached the steamer *Islay*, anchored under the lee of one of the small islands of the bay, and were fortunate in finding among the not too numerous passengers several whose society added to the interest of the voyage.

One of the effects of the habitual use of maps on a small scale is that untravelled persons, even though conversant with the facts of geography, feel it difficult to realize the great dimensions of the more distant parts of the world as compared with our diminutive European continent. Thus it came on me with something of surprise that the Bay of Panama is fully a hundred and twenty sea miles across from headland to headland, and that the run from Panama to Callao, which is scarcely one-third of the length of the South American continent, is rather longer than that from Bergen to the Straits of Gibraltar. The case, of course, is much worse with those accustomed to use maps on Mercator's projection. It profits nothing to explain, even to the most intelligent youth, the nature and amount of the errors involved in that mode of representing a spherical surface on a plane. I verily believe that all the mischief done by the stupidity, ignorance, and perversity of the writers of bad school-books is trifling compared to the amount of false ideas spread through the world by the productions of that respectable Fleming.

The steamers of the Pacific Mail Company employed for the traffic between San Francisco and Valparaiso are as perfectly suited to the peculiar conditions of the navigation as they would be unfit for long sea-voyages in any other part of the world. In the calm waters of this region, rarely ruffled even by a stiff breeze, the fortunate seamen engaged in this service know no hardships from storm or cold. Their only anxiety is from the fogs that at some seasons beset parts of the coast. In each voyage they pass under a vertical sun, but the air and the water are cooler than in any other part of the equatorial zone; and all that is needed for their physical comfort, and that of their passengers, is free ventilation and shade from the sun. These desiderata are fully secured. The main-deck is open to the air, and the steerage passengers, who are encamped amidships and on the fore-deck, are satisfied at night with the amount of privacy secured by hanging some piece of stuff to represent a curtain round each family group. On the upper deck are ranged the state rooms of the first-class passengers, each with a door and window opening seaward. Above this, again, a spar-deck carried flush from stem to stern affords ample opportunity for exercise, and is itself sheltered from the sun by an awning during the hot hours. In such conditions, where merely to breathe is to enjoy, the only danger is that of subsiding into mere lotus-eating. From this I was fortunately preserved by the rather troublesome task of drying in satisfactory condition the plants which I had hastily gathered in Jamaica and in crossing the isthmus.

PACIFIC COAST STEAMERS.

I had supposed that the distinctly green colour of the water in Panama Bay, so different from the blue tint of the open Atlantic, might be due to some local peculiarity; but on the following day, April 7, while about a hundred miles from land, I observed that the same colour was preserved, and I subsequently extended the observation along the coast to about 5° south, where we encountered the antarctic current. Farther south I should describe the hue of the water as a somewhat turbid dark blue, reminding one of the water of the North Atlantic as seen in approaching the British Islands.

At daybreak on April 8 we found ourselves approaching the port of Buenaventura. Long before it was possible to land I was ready, thrilling with interest and curiosity respecting a region so entirely new – an interest enhanced, perhaps, by the extent of ignorance of which I was inwardly conscious. Knowing this place to be the only port of an extensive tract, including much of the coast region of New Granada, lying only a few degrees from the equator, and rich in all sorts of tropical produce, I had formed a very undue idea of its importance. Although the rise and fall of the tide are very moderate on this coast, the ricketty wooden wharf could not be reached at low water. There was nothing for it but to land on the mud, and scramble up the slippery slope to the top of the bank of half-consolidated marl, from twenty to forty feet above the shore, on which the little town is built. It consists of some two hundred houses and stores, nearly all mere plank sheds, but, as usual throughout South America, the inhabitants rejoice in dreams of future wealth and importance to be secured by a railway communicating with the interior. There was no time to be lost; notice had been given that the ship's stay was to be very brief, and even before landing it was apparent that the tropical forest was close at hand. In truth, the last houses are within a stone's throw of the skirts of the forest. Just at this point I was attracted by a leafless bush, evidently one of the spinous species of *Solanum*, with large, yellow, obversely pear-shaped fruits. As I was about cutting off a specimen, the people, who here seemed very friendly, rushed out of the nearest house and vociferated in warning tones, “Mata! mata!” I was afterwards assured that the fruit is here considered a deadly poison. It appears to be one of the rather numerous varieties of *Solanum mammosum*, a species widely spread through the hotter parts of America.

FIRST VIEW OF A TROPICAL FOREST.

Being warned not to go out of hearing of the steam-whistle that was to summon us back to the ship, I was obliged to content myself with three short inroads into the forest, through which numerous paths had been cleared. The first effect was perfectly bewildering. The variety of new forms of vegetation surrounding one on every side was simply distracting. Of the larger trees I could, indeed, make out nothing, but the smaller trees and shrubs, crowded together wherever they could reach the daylight, were more than enough to occupy the too short moments.

Of the general character of the climate there could be no doubt. In spite of the blazing sun, with a shade temperature of about 85° Fahr., the ground was everywhere moist. Ferns and *Selaginellæ* met the eye at every turn, with numerous *Cyperaceæ*; and in an open spot, among a crowd of less familiar forms, I found a minute *Utricularia*, scarcely an inch in height. But the predominant feature, and that which interested me most keenly, was the abundance and variety of *Melastomaceæ*. Within the first ten minutes I had gathered specimens of seven species, all of them but one large shrubs. Of the climbers and parasites that give its most distinctive features to the tropical forest, I could in so hurried a peep make out very little. I owe one beautiful species, hitherto undescribed, to my friend W – , who, having wandered in another direction, spied the scarlet flowers of the epiphyte, which I have named *Anthopterus Wardii*, on the trunk of a tree, which was promptly climbed by the active negro who had accompanied him.[1]

Too soon came the summons of the steam-whistle. As we called on our way at the office of the Pacific Company's agent, we were shown a number of the finer sort of so-called Panama hats, which are chiefly made on this part of the coast. Even on the spot they are expensive articles, a hundred dollars not being considered an unreasonable price for one of the better sort.

Some writers of high authority on geographical botany have held that the most marked division of the flora of tropical South America is that between the regions lying east and west of the Andes. It would be the extreme of rashness for one who has seen so little as I have done of the vegetation of a few scattered points in so vast a region to attempt to draw conclusions from his own observations; but, on the other hand, writers in Europe, even though so learned and so careful as Grisebach and

[1] For a list of the plants collected here, see a paper in the *Journal of the Linnæan Society*, vol. xxii.

Engler, are under the great disadvantage that the materials available, whether in botanical works or in herbaria, are generally incomplete as regards localities. How is it possible to form any clear picture of the flora of a special district when so large a proportion of the plants recorded are merely said to come from "Columbia" or "Ecuador," the one larger than Spain, France, and the Low Countries put together, the other equal in extent to the Austrian Empire, and both traversed by mountain ranges varying from fifteen thousand to over eighteen thousand feet in height? I shall have later to make some remarks on the climatal conditions of the coast region extending from Panama to the Bay of Guayaquil, but I may here mention that when I afterwards acquired some slight acquaintance with the flora of Brazil, I was struck with the fact that, although separated by an interval of nearly three thousand miles, and by the great barrier of the Andes, the plants seen in and around the forest at Buenaventura were almost all nearly allied to Brazilian forms.

FLORA OF TROPICAL SOUTH AMERICA.

Further reflection, and such incomplete knowledge as I have been able to acquire as to the flora of inter-tropical South America, lead me to the conclusion that the present vegetable population of this vast region is, when we exclude from view a certain number of immigrants from other regions, mainly derived from two sources. There is, in the first place, the ancient flora of Guiana and tropical Brazil, which has gradually extended itself through Venezuela and Columbia, and along the Pacific coast as far as Ecuador, and, in an opposite direction, through Southern Brazil, to the upper basins of the Uruguay, the Paranà, and the Paraguay. The long period of time occupied by the gradual diffusion of this flora is shown by the large number of peculiar species, and not a few endemic genera that have been developed throughout different parts of this vast region, whose nearest allies, however, are to be found in the original home, Guiana or Brazil. Along with this stock, which mainly occupies the lower country, we find, especially in Venezuela, Columbia, and Ecuador, the modified descendants of vegetable types characteristic of the Andes. Of the Andean flora I shall have something to say in a future page; but I may express the belief that if we go back to the remote period when most of the characteristic types of the vegetation of South America came into existence, we must seek the ancestors of the Brazilian flora, and to a large extent also those of the Andean flora, in the ancient high mountain ranges of Brazil, where we now see, in the vast extent of arenaceous rocks, and in the surviving pinnacles of granite, the ruins of one of the greatest mountain regions of the earth.

Early on Easter Sunday morning, April 9, we were off Tumaco, a small place on one of a group of flat islands lying at the northern extremity of the coast of Ecuador.[2] These islands are of good repute as having the healthiest climate on this coast. Although close to the equator, cattle are said to thrive, and, if one could forget the presence of a fringe of cocos palms along the shore, the island opposite to us, in great part cleared of forest, with spreading lawns of green pasture, might have been taken for a gentleman's park on some flat part of the English coast. We here parted with General Prado, ex-president of Peru, who has purchased one of the islands, and hopes to end his days peacefully as a cattle-breeder. Nothing in his manner or conversation announced either energy or intelligence, but it is impossible not to recognize some kind of ability in a man who, having held such a post at such a time, not only succeeded in escaping the ordinary fate of a Peruvian president – his two immediate predecessors having been assassinated – but also in snatching from the ruin of his country the means of securing an ample provision for himself at a safe distance from home.

In the almost cloudless weather that has prevailed for some days, the apparent path of the sun could not fail to attract attention. Being still so near the vernal equinox, this could not be distinguished from a straight line. Rising out of the horizon at six o'clock, the sun passed exactly through the zenith, and went down perpendicularly in the west into the boundless ocean. Who can wonder that this daily disappearance of the sun has had so large a share in the poetry and the religion of our race? In every

[2] Much cinchona bark, coming from the interior, was formerly shipped at Tumaco; but between horrible roads and the reckless waste of the forests through mismanagement, but little is now conveyed by this way.

land, under every climate, it is the one spectacle which is ever new and ever fascinating. Use cannot stale it; and knowledge, which is said to be driving the imagination out of the field of our modern life, has done nothing to weaken the spell.

We awoke next day to find ourselves in the southern hemisphere, having crossed the line about three a.m. As the morning wore on we passed abreast of the Cabo San Lorenzo, and towards evening, keeping nearer to the coast, were within a few miles of Cabo Santa Elena. This forms the north-western headland of the Gulf of Guayaquil, a wide bay that extends fully a hundred miles eastward from the coastline.

At daybreak, April 11, we were inside the large island of Puna, and soon after entered the mouth of the river Guayas. Although it drains but a small district, this has a deep channel, as wide as the Thames at Gravesend, making the town of Guayaquil, which is about thirty miles from its mouth, the natural port for Western Equatorial America. As we steamed northward up the stream, every eye was turned eastward with the hope of descrying some part of the chain of the Andes. It was, indeed, obvious that a great mountain barrier lay in that direction, and beneath the eastern sun dark masses from time to time stood out to view; but along the crest of the range heavy banks of cloud constantly rested, and the summits remained concealed. We knew that the peak of Chimborazo is scarcely more than seventy miles distant from Guayaquil, and is easily seen from the town in clear weather; but we did not know that clear weather is a phenomenon that recurs only on about half a dozen days in the course of the year, and it is needless to say that we did not draw one of these prizes in the lottery. I had been conscious of a distinct change of climate during the preceding night, and this was still more marked after we entered the river. The increase of temperature was but trifling. The thermometer at sea during the two preceding days had ranged from 77° to 79°, and here at nine a.m. it marked only 80°; nor did it ever rise above 84° while we lay opposite Guayaquil. But the sense of oppressive closeness was more or less felt by every one, and, whatever may be the cause, it seems safe to conclude that the notoriety of this city as one of the most unhealthy in South America is intimately connected with it.

PHYSIOLOGICAL EFFECTS OF HOT CLIMATES.

There is, no doubt, much yet to be learned as to the effects of climate on the human constitution, but a few points seem to be sufficiently ascertained. To those whose constitution has been hereditarily adapted to a temperate or cold climate, the enfeebling effect of hot countries depends much more on the constant continuance of a high temperature than on its amount. A place with a mean temperature of 80° Fahr., which varies little above or below that point, is far more injurious to a European than one where intervals of great heat alternate with periods of cooler weather. Still more important, perhaps, is the effect of a hot climate in places where the air is habitually nearly saturated with aqueous vapour. When the temperature of the skin is not much greater than that of the surrounding air, if this be near the point of saturation but little evaporation can take place from the surface. The action of the absorbent vessels is thus checked, and the activity of all the functions is consequently lowered. As it usually happens that the two agencies here discussed act together in tropical countries, the places having a uniform temperature being also for the most part those having an atmosphere heavily charged with vapour, it is easy to understand that Europeans whose vitality is already depressed are especially exposed to suffer from whatever causes induce endemic or epidemic disease. The difficulty in connection with this subject is to explain certain exceptions to the general rule. In several places in the tropics, usually insular stations, where a steady high temperature is combined with the presence of much vapour, the climate is said to have no injurious effects. But the most marked exception seems to be that of seamen. Excluding that large majority whose calling involves frequent changes of climate, there must be now a considerable body of experience respecting those who for a series of years have navigated tropical seas exposed to nearly uniform temperature. I am not aware that there are any facts to sustain the supposition, which might *à priori* seem plausible, that such a life tends to enfeeble the European constitution.

Between a broad fringe of mangrove swamp, backed by a narrow border of forest on either bank, with little to break the monotony of the way, we reached Guayaquil before ten a.m. Seen from the river, with many large buildings and stores covering more than a mile of frontage on the western bank, and a straggling suburb stretching to the base of a low hill to the northward, the city presents an unexpectedly imposing appearance. The present amount of trade is inconsiderable, but if ever these regions can attain to the elementary conditions of good government the development of their natural resources must entail a vast increase of business. The territory of Ecuador includes every variety of climate, and is in great part thoroughly suited to Europeans. All tropical products are obtainable, and, with good management and kindly treatment, the supply of efficient negro labour at moderate wages is considerable. Among other products of the soil, the tobacco of the country about Guayaquil deserves to be better known. Of the many varieties of the coarser kind which are grown throughout Central and South America, this appears to me the best, as it certainly is the cheapest. The hawkers who came on board sold at less than seven shillings a hundred cigars of very fair quality, making, as I was told, a profit of fifty per cent.

ALLIGATORS OF THE RIVER GUAYAS.

It might be not unworthy of the notice of the great steamboat companies to recommend to their agents some little consideration for passengers who travel to see the world. It commonly happens that on the arrival of a steamer, after the first conference between the agent and the captain, a time is fixed for departure which has no relation to the hour really intended. We were told this morning that the steamer was to start at one p.m. The time was clearly too short for an excursion to the neighbouring country, and the inducement to spend a couple of hours in the streets of such an unhealthy town was very trifling. Two young Englishmen went up the river in a boat with the hope of shooting alligators. These creatures abound along the banks of the Guayas, basking in the mud, and looking from a distance like the logs that are floated down by the stream. Our sportsmen had the usual measure of success, and no more. For a bullet to pierce the dense covering that shields this animal is a happy accident, but it suffices to disturb the creature from his rest, and to induce him to crawl or roll into the river, and to accomplish this is at least a new experience. Through the courtesy of a native gentleman, the travellers were induced to land at a *hacienda* on the river, where horses were provided, and they galloped back to the town before one o'clock. Meanwhile the Jamaica story was repeated. It was announced that the agent had decided to keep the steamer till three p.m.; and finally we learned that we should remain at our moorings till early next morning.

On her last voyage the *Islay* had started too late; night fell before she cleared the mouth of the river, and, in the dark, she had run down a *chatta*– one of the cumbrous native barges that ply along the stream. Of fifteen natives in the barge thirteen were saved, three of them by the courage and activity of the chief officer, who jumped into the river to their rescue. Our captain very properly objected to the risk of another similar accident, and decided to wait for daylight. The cause of the delay remained a mystery, for all that was shipped of passengers and cargo was of a kind that did not seem likely to be very remunerative. At first sight it appeared merely as a characteristic of a rude state of society that the country people around Guayaquil are used to embark on the southward-bound steamers with tropical fruit raised by themselves, which they carry to Lima, and even as far as Valparaiso, dispose of at a handsome profit, and then return home. As most of the profit must go into the coffers of the Pacific Steam Company, the motive is not very obvious; but after a little further experience I fully understood it. Even if they clear little more than the price of their passage, these people find their advantage in undertaking an annual expedition of this kind. Apart from the very positive benefit to health, they gain what they like most in the world – a season of absolute idleness, with the amusement of seeing new objects and talking to new people. For the remainder of the voyage the main-deck was crowded and somewhat encumbered by picturesque groups of rough men, some accompanied by womankind, alternating with huge heaps of tropical fruit – pineapples and bananas, a single bunch of the latter sometimes weighing more than a hundred pounds.

GULF OF GUAYAQUIL.

The thermometer scarcely varied by a small fraction from 80° throughout the night and the following day, until we had cleared the Gulf of Guayaquil; and even at this moderate temperature the feeling of lassitude continued as on the previous day. Of the famous mosquitos of the river Guayas we had little experience. They are said sometimes to attack in swarms so numerous and ferocious that, even by day, it becomes difficult for officers and men to manage a ship on the river.

The sun had set on the following evening, April 12, before we were well abreast of Cabo Blanco, the southern headland of the Gulf of Guayaquil, and we saw nothing of its southern shore. About one-half of this belongs to Peru, and close to the frontier-line is the little port of Tumbez, sometimes visited by passing steamers. I was assured by two of the ship's officers that the climate and vegetation of this place are much the same as at Guayaquil, but there are few parts of the American coast that better deserve careful examination by a scientific naturalist.

During the night of the 12th we passed Cape Parinas, the westernmost headland of South America, and before sunrise were in the roads of Payta. Being aware that the so-called rainless zone of Peru extends northward to this place, I was especially anxious to see as much of it as possible. During the night the temperature had fallen, especially after rounding Cape Parinas, and at sunrise stood at 74°. In the cooler air, and under the excitement of pleasant anticipation, the lassitude of the two preceding days utterly disappeared; and as day dawned I stood on deck, with my tin box slung to my back, ready to go ashore long before there was any possibility of doing so. The officers told me, indeed, that there was no use in taking a botanical box, as the country about Payta was absolutely without vegetation. I have many times had the same assurance given me, but the time had not yet come when I was to find it correct, and I felt that Payta was not one of such rare spots on the earth.

The appearance of the place and of its surroundings is unquestionably very strange, and the contrast between it and the shores of the neighbouring Gulf of Guayaquil is simply marvellous. Saving the presence of a mean little modern church, with two shabby wooden towers coated with plaster, the aspect of the little town reminded me of Suez, with the difference that the surrounding desert is here raised about a hundred feet above the sea-level. The place, I presume, is improved since it was visited and described by Squiers, and I found that on the slope between the base of the plateau and the beach there is ample space for some mean streets.

FLORA OF PAYTA.

With several companions who were kind enough to interest themselves in plant-hunting, I at once turned towards the sea-beach at the south-western side of the town, keeping along the base of the low cliffs that here descend to the water's edge. The seaward face of the cliffs is furrowed by numerous gullies, and in one of the broadest of these I was delighted to observe numerous stunted bushes well laden with crimson flowers. This turned out to be *Galvesia limensis*, a plant found only at a few spots in Peru, whose nearest but yet distant European ally is the common snapdragon. In the upper part of the same gully were the withered remains of several other species, most of which have been since identified. Emerging on the plateau, we found ourselves on a wide plain, apparently unbroken, leading up to a range of hills some fifteen or twenty miles distant. Though we were here only five degrees from the equator, and before we returned to the ship the sun had risen as high as on a summer's noon in England, the southerly breeze felt delightfully cool and fresh, and at midday, under the vertical sun, the temperature on board ship was not quite 75°.

Vegetation, as I anticipated, was not entirely absent from the plateau, but it was more scarce than I had anywhere seen it, except in the tracts west of the Nile above Cairo, where the drifting sands covers up and bury everything on the surface. In the northern Sahara, about Biskra, where rain is much less infrequent than here, vegetation, though scanty, is nearly continuous, and it is not easy to find spaces of several square yards absolutely without a single plant. About Suez, and on parts of the isthmus where a slight infiltration from the sweet water canal has not developed a more varied vegetation, the number of species in a given tract is often very limited; but tufts of vigorous growth,

especially of the salt-loving species, are seen at frequent intervals. On the plateau of Payta, where, as we rambled about, several pairs of eyes were on the alert, but a single tuft of verdure visible at a distance could be made out. This was formed by several bushes of *Prosopis limensis* growing together. Elsewhere the few plants seen were confined to the occasional shallow depressions where rain rests longest. All, of course, had perennial roots, and scarcely one of them rose as much as three inches from the ground.[3]

I found it difficult to account for the origin of the sands which are sparingly scattered over the plateau, but accumulated to a considerable depth on the slopes behind the town. The underlying rock seen in ascending to the plateau is a tolerably compact shale; but the hard crust forming the superficial stratum appears to consist of different materials, and not to be made up from the disintegrated materials of the shale. At several places, both below the cliffs and on the plateau, I found large scattered fragments of what appeared to be a very recent calcareous formation, largely composed of shells of living species; but this was nowhere seen *in situ*, and I was unable to conjecture the origin of these fragments.

CLIMATE OF NORTHERN PERU.

Before returning to the *Islay*, I had the advantage of a short conversation with the very intelligent gentleman who acts as British consular agent at Payta, and whose ability would perhaps be seen to advantage in a more conspicuous post. The information received from him fully confirmed the impressions formed during my short excursion. The appearance of the gullies that furrow the seaward face of the plateau sufficiently showed that, however infrequent they may be, heavy rains must sometimes visit this part of the coast. I now learned that, in point of fact, abundant rain lasting for several days recurs at intervals of three or four years, the last having been seen in the year 1879. As happens everywhere else in the arid coast zone, extending nearly two thousand miles from Payta to Coquimbo in North Chili, abundant rainfall is speedily followed by an outburst of herbaceous vegetation covering the surfaces that have so long been bare. During the long dry intervals slight showers occur occasionally a few times in each year. These are quite insufficient to cause any general appearance of fresh vegetation, but suffice, it would seem, to maintain the vitality of the few species that hold their ground persistently. The ordinary supply of water in Payta, obtained from a stream descending from the Andes seventeen miles distant, is carried by donkeys that are despatched every morning for the purpose. There was something quite strange in the appearance of a few bundles of fresh grass which we saw in the *plaza*. They had come that morning by the same conveyance for the support of the very few domestic animals that it is possible to keep in such a place.

The problems suggested by the singular climatal conditions of this region of South America have not, I think, been as fully discussed as they deserve to be, and I here venture on some remarks as a contribution to the subject.

The existence of the so-called rainless zone on the west coast of South America is usually accounted for by two agencies whose union is necessary to produce the result. The great range of the Andes, it is said, acts as a condenser on the moisture that is constantly carried from the Atlantic coasts by the general westward drift of the atmosphere in low latitudes. The copious rainfall thus produced on the eastern slopes of the great range leaves the air of the highlands of Peru and Bolivia relatively dry and cool, so that any portion that may descend to the coast on the western declivity tends to prevent rather than to cause fresh aqueous precipitations. Meanwhile the branch of the Antarctic Ocean current known as the Humboldt current, which sets northward along the sea-board from Western Patagonia, is accompanied by an aërial current, or prevailing breeze, which keeps the same direction. The cold air flowing towards the equator, being gradually warmed, has its capacity for holding vapour in suspension constantly increased, and is thus enabled to absorb a large portion of the vapour contained in the currents that occasionally flow inland from the Pacific, so that the

[3] For a list of the species collected, see the *Journal of Linnæan Society*, vol. xxii.

production of rain is a rare event, recurring only at long intervals. Admitting the plausibility of this explanation, a first difficulty presents itself. If the Andes act as a barrier against the vapour-laden atmosphere of eastern tropical America throughout Peru, Bolivia, and Northern Chili why, it may be asked, do they fail to perform the same function in Ecuador and Colombia? Whence the absolute contrast in point of climate that exists between these regions? Why is the littoral zone between the Gulf of Guayaquil and that of Panama, a distance of some eight hundred miles, not merely less dry than that of Peru, but actually more moist than most parts of the coast of Brazil or Guiana?

CAUSES OF THE ARID COAST CLIMATE.

Some answer may, I think, be given to these questions. In the first place, comparing the orography of Peru and Bolivia with that of Ecuador, some important differences must be noted. In Eastern Peru, as is at once shown by the direction of the principal rivers, we find no less than four parallel mountain ranges, increasing in mean elevation as we travel from east to west. The westernmost range, to which in Peru the name *Cordillera* is exclusively applied, does not everywhere include the highest peaks, but has the highest mean elevation. The second range, exclusively called *Andes* in Peru, rivals the first in height and importance. I know of no collective names by which to distinguish the third range, dividing the valley of the Huallaga from that of the Ucayali, nor the fourth range, forming the eastern boundary of the latter stream. In South Peru and Bolivia the mountain ranges are less regularly disposed, but cover a still wider area; and throughout the whole region it is obvious that the warm and moist currents drifting slowly westward have to traverse a zone of lofty mountains varying from four to six hundred miles in width, and can carry no moisture available to produce rain on the western seaboard. In Ecuador the two principal ranges – the Cordillera and the Andes – are much nearer together than they usually are in Peru, and no parallel ranges flank them on the east. The numerous tributaries of the Maranon flow in a tolerably direct course east or south-east, many of them rising within a hundred and fifty miles of the Pacific coast. It follows that the atmospheric currents meeting less preliminary obstruction reach the eastern slopes of the main range still very heavily charged with vapour. In crossing the barrier a large portion of the burthen must be deposited; but it is probable that a large amount is nevertheless carried to the western side of the range.

It may be said that this explanation, whatever it may be worth, cannot apply to the territory of Colombia, where the Andes are broken up into at least three lofty ranges, and the mountains cover as wide a space as they do in Peru. My impression is that the abundant supply of moisture on the west coast of Colombia arises from a different source. The effects of the Isthmus of Panama as a barrier against atmospheric currents must be absolutely insignificant, and I have no doubt that those which flow eastward along the coast of the Caribbean Sea are in part diverted south-east and south along the west coast of Colombia.

There can, however, be little doubt that in determining the climate of the west coast the influence of the Humboldt current, and of the cool southerly breezes that accompany it, is far greater than that of the disposition of the mountain ranges. A glance at the map shows that about the fifth and sixth degrees of south latitude the direction of the coast undergoes a considerable change. On the voyage from Panama, we had hitherto steered somewhat west of south; henceforward our course lay between south-south-east and south-east. All the currents of the ocean and atmosphere, whose existence arises from the unequal distribution of heat on the earth's surface, vary somewhat in their course throughout the year with the changes of season, and this doubtless holds good on the American coast. I believe, however, that both the sea and air currents from the south are normally deflected away from the coast at the promontory of Ajulla (sometimes written "Ahuja"), a short distance south of Payta. A further portion is again deflected westward at Cape Parinas, north of which headland they seem not to be ordinarily met. I infer, however, from the testimony of seamen, that at some seasons they are felt near the coast as far north as the equator, and even beyond it. This inference was confirmed by observing the parched appearance of the seaward slope of Cabo Sta. Elena, north

of the Gulf of Guayaquil, which apparently does not fully share in the frequent rains that elsewhere visit the coast of Ecuador.

INFLUENCE OF THE HUMBOLDT CURRENT.

Whatever force there may be in the above suggestions, I confess that they do not seem to me adequate to account for the extraordinary difference of climate between places so near as Payta and Tumbez – not quite a hundred miles apart – and I trust that further light may be thrown upon the matter by a scientific traveller able to spare the necessary time. So far as I know, no such abrupt and complete a change is known elsewhere in the world. I was unable to obtain any information as to a range of hills or mountains, marked in Arrowsmith's map "Sa. Amatapi," which appears to extend east or east-north-east from Cape Parinas. Its height can scarcely be considerable, as it does not appear to have attracted the attention of the seamen who are familiar with this coast; but, on the other hand, there is some reason to think that the southerly breezes prevailing on the coast do not extend to any great height above the sea-level. It would be interesting if we should find on the opposite sides of a range of unimportant hills the same contrasts of climate and vegetation that are known to prevail between the eastern and western slopes of the Peruvian Andes.[4]

Along the coast of Northern Peru are numerous small islets, evidently at some period detached from the continent either by subsidence or by marine erosion. Here, in the almost complete absence of rain, were formed those secular accumulations deposited by sea-birds, which, when known in Europe under the name of *guano*, suddenly rivalled the mines of the precious metals as sources of easily acquired wealth. The two most considerable groups are respectively named Lobos de tierra and Lobos de afuera; a smaller group near to Payta is also called Lobos. At the western end of the largest of the latter group the waves have excavated a natural arch, which, after a sufficient period of further excavation, will fall and give rise to a new detached islet. A brisk southerly breeze made the air feel cooler than it had done since we entered the tropics, as we ran about due south until sunset, when, after passing abreast of the promontory of Ajulla, our course was altered to nearly due south-east. I was assured by a native passenger that the promontory of Ajulla, for a distance of thirty or forty miles, is an absolute desert, without a drop of water or the slightest trace of vegetation. Experience has made me somewhat sceptical as to statements of this nature made by non-scientific observers. During the day we frequently observed a fish which appears distinct from the flying-fish of the Atlantic. The pectoral fins appear to be less developed, and in consequence the flight is shorter, and the animal seems to have less command over its movements.

GUANO ISLANDS.

Our course on April 14 lay rather far from land. It was known that yellow fever had broken out at Truxillo, and it was decided that we should run direct to Callao, without touching at that or any of the smaller places on the coast sometimes visited by the steamers. Although the air appeared to be somewhat hazy, the range of the Cordillera, more than a hundred miles distant, was distinctly seen in the afternoon. Very soon after we ran into a dense bank of fog, in which we were immersed for several hours, our cautious captain remaining meanwhile on the bridge, and the frequent cry of the steam-whistle ceased only when we steamed out of the fog into a brilliant star-lit night.

LOW TEMPERATURE OF THE COAST.

These fogs, which are frequent along the Peruvian coast, are the chief, if not the only, difficulty with which the navigator has to contend. When they rest over the land it becomes extremely difficult

[4] The abrupt change in the vegetation on this part of the American coast has been noticed by Humboldt, Weddell, and other scientific travellers. In a note to the French edition of Grisebach ("Vegetation du Globe," traduit par P. de Tchihatcheff, ii. p. 615), M. André expresses the opinion that this, as well as some other cases of abrupt change in the vegetation observed by him in Colombia, are to be explained by the nature of the soil, which in the arid tracts is sandy or stony, and fails to retain moisture. Admitting that in certain cases this may afford a partial explanation of the facts, it is scarcely conceivable that the limit of the zone wherein little or no rain falls should exactly coincide with a change in the constitution of the soil, and I should be more disposed to admit a reversed order of causation, the porous and mobile superficial crust remaining in those tracts where, owing to deficient rainfall, there is no formation of vegetable mould, and no accumulation of the finer sediment forming a retentive clay.

to make the ports, and at sea they involve the possible risk of collision. If this risk is at present but slight, it must become more serious when intercourse increases, as it must inevitably do if the Ship Canal should ever be completed; and for the general safety it may be expedient to prescribe special rules as to the course to be taken by vessels proceeding north or south along the coast. The origin of the fogs must be obvious to any one who considers the physical conditions of this region, to which I have already referred. The air must be very frequently near the point of saturation, and a slight fall of temperature, or the local intermixture of a body of moister air, must suffice to produce fog. The remarkable thing is that this should so very rarely undergo the further change requisite to cause rain. To some young Englishmen on board, the remarkable coolness of the air along this coast was a continual subject of jesting comment; and on more than one occasion the "Tropics" were emphatically declared to be "humbugs." It is certain that for thirty-six hours before reaching Callao the shaded thermometer never reached 70°, and stood at noon, with a clear sky and a brisk southerly breeze, no higher than 68°.

CHAPTER II

Arrival at Callao – Quarantine – The war between Chili and Peru – Aspect of Lima – General Lynch – Andean railway to Chicla – Valley of the Rimac – Puente Infernillo – Chicla – Mountain-sickness – Flora of the Temperate zone of the Andes – Excursion to the higher region – Climate of the Cordillera – Remarks on the Andean flora – Return to Lima – Visit to a sugar-plantation – Condition of Peru – Prospect of anarchy.

The steam-whistle, sounding about daybreak on April 15, announced that we were again wrapped in fog. As the *Islay* advanced at half speed the fog lightened without clearing, until about nine a.m. we made the island of San Lorenzo, and, as the haze finally melted away into bright sunshine, found ourselves half an hour later in the harbour of Callao. The moment was exciting for those who, like myself, approached as strangers the shore which had in our childhood seemed so strange, so adventure-fraught, so distant. Already some one had pointed out the towers of the Cathedral of Lima, with the Cordillera apparently so near that the mountains must begin outside the gates. All stood on deck prepared to land – some already looking forward to luncheon in the city of Pizarro – and waiting only for the usual formalities of the visit of the *sanidad*. At length the officials came, and, after the usual parley over the ship's side, it became apparent that the visit was no mere formality. At last the ominous word *quarantine* was heard, received at first with mere incredulity, as something too absurd, but at last taking the consistence of a stern fact. Since the outbreak of yellow fever among the troops at Truxillo, the Chilian authorities have naturally become nervously anxious to protect the occupying army from this danger, and every precaution is put in force. Under these circumstances, a ship coming from Guayaquil was naturally an object of suspicion. There certainly was not at the time any epidemic fever at that place; but, if reports be true, sporadic cases are not unfrequent, and that city is rarely, if ever, quite free from malignant zymotic disease. At last the discussion was closed, by a definite order that we should repair to the quarantine ground under the lee of the island of San Lorenzo.

IN QUARANTINE AT CALLAO.

Up to this time we had scarcely given attention to the scene immediately surrounding us; yet the harbour of Callao is at any time an interesting sight, and at this moment its aspect was peculiarly expressive. Although the Chilian forces had before this time become absolute masters of the entire seaboard of Peru, and there was no reason to apprehend any renewal of the struggle by sea, the memorials of the desperate encounters which marked the earlier phase of the war were here still fresh. Near the shore in several different directions were the wrecks of ships which had sunk while the captors were endeavouring to bring them into harbour, the masts sticking up idly above water and doing the duty of buoys. Still afloat, though looking terribly battered and scarcely seaworthy, was that remarkable little ship, the *Huascar*, looking a mere pigmy beside the warships in the harbour from which the Chilian, American, French, and Italian flags were flying, England being for the moment unrepresented.

The naval war between Chili and Peru was conducted at such a distance from Europe, and its causes were so little understood, that it excited but feeble interest. Even the circumstance that, in an encounter brought about by the incompetence and rashness of a British commander, the pigmy Peruvian force was able with impunity to inflict an affront on the national flag, scarcely excited in England more than momentary surprise. Nevertheless the story of the war, which yet awaits an impartial chronicler,[5] abounds with dramatic incident. The record is ennobled by acts of heroic

[5] The only detailed account of the operations that I have seen is in a work entitled, "Histoire de la Guerre du Pacifique," by Don Diego Barros Arana. Paris: 1881. It appears to be fairly accurate as to facts, but coloured by very decided Chilian sympathies.

bravery on both sides, while at the same time it suggests matter for serious consideration to the professional seaman. The important part which small fast ships, carrying one or two heavy guns only, may play in the altered conditions of naval warfare has been often pointed out, but has been practically illustrated only in the war between Chili and Peru. It does not seem as if the importance of the lesson had been yet fully appreciated by those responsible for the naval administration of the great European powers.

For the remainder of the day, and during the whole of the 16th, we lay at anchor about half a mile from the shore of the island of San Lorenzo, a bare rough hill, mainly formed, it would seem, of volcanic rock overlaid in places by beds of very modern formation. All naturalists are familiar with the evidence adduced by Darwin, proving the considerable elevation of the island and the adjacent mainland since the period of the Incas, as well as Tschudi's arguments going to show that in more recent times there has been a period of subsidence.

BLACK PELICANS.

Of the objects near at hand the most interesting were the large black pelicans which in great numbers frequent the bay or harbour of Callao, attracted, no doubt, by the offal abundantly supplied from the town and the shipping. Seemingly indefatigable and insatiable, these birds continued for hours to circle in long sweeping curves over the water, swooping down on any object that attracted their appetite. The body appears to be somewhat slighter than that of the white pelican of the East, but the breadth of wing and length of the neck are about the same. When on the wing the plumage appears to be black, but in truth it is of a dark bluish slate colour.

Our detention in quarantine might have been prolonged but for the fortunate circumstance that the contents of the mail-bags carried by the *Islay* were at this moment the object of anxious curiosity to the Chilian authorities, and to the representatives of foreign powers. The position of affairs was already sufficiently critical, and the attitude recently assumed by the Government of the United States had added a new element of uncertainty to the existing difficulties. Mr. Hurlbut, the last American representative, had died, and Mr. Trescott, who supplied his place, was ostensibly charged with the attempt to bring about a peace between Chili and Peru, but was supposed to be chiefly intent on extricating his Government from a position into which it had been led by a series of proceedings which had neither raised the national reputation nor secured the good-will of either Chili or Peru.

While we lay off the harbour, watched day and night by the crew of a launch stationed beside us to prevent communication with the land, we received three successive visits from the officers of the American man-of-war lying in the harbour, who approached near enough to hold conversation with our captain. The message was a request, finally conveyed in somewhat imperious terms, that the dispatches addressed to the American envoy should at once be delivered. The American foreign office is not, I believe, accustomed to forward diplomatic dispatches in a separate bag, but merely uses the ordinary post. Our captain properly declined to take the responsibility of opening the mail-bags, which he was bound to deliver intact to the postal authorities as soon as we were admitted to pratique. The result was that on Monday, just as we were beginning to be seriously uneasy at the prospect of a long detention, a steam launch was seen to approach, having a number of officials on board. A seemingly interminable conversation between these and the captain and medical officer of our ship finally resulted in a Chilian medical man coming on board to make a careful examination of the ship, the crew, and the passengers. After we had been duly marshalled and inspected – the first-class passengers on the spar-deck, the others on the main-deck – the welcome announcement, "Admitted to pratique," ran through the ship. Not much time was lost in moving up to the proper moorings in the harbour, some two miles distant, and about noon we were set on land close to the custom-house.

LANDING AT CALLAO.

The boatmen, the porters, and the nondescript hangers-on about the quays of a port, formed a strange and motley assemblage, in whose countenances three very distinct types of humanity – the

European, the negro, and the South American Indian – were mingled in the most varied proportions, scarcely one denoting an unmixed origin. The arrangements at Callao are convenient for strangers. The custom-house officers, though unbribed, gave no trouble, and the rather voluminous luggage of six English passengers was entrusted to a man who undertook for ten *soles* (about thirty-three shillings) to convey the whole to the chief hotel in Lima. No time was left to see anything of Callao. A train was about to start; and in half an hour we were carried over the level space – about seven and a half miles – that separates Lima from the port of Callao.

Occupied by the forces of her victorious rival, and shorn of most of the almost fabulous wealth that once enriched her inhabitants, Peru can, even in her present ruined state, show a capital city that impresses the stranger. It is true that the buildings have no architectural merit, that most of the streets are horribly ill-paved, and that at present there is little outward appearance of wealth in the thoroughfares; in spite of all this the general aspect is novel and pleasing. Although violent earthquakes have rarely occurred in this region, slight shocks are very frequent, and remind the inhabitants that formidable telluric forces are slumbering close at hand. Hence, as a rule, the houses have only a single floor above the ground, and cover a proportionately large space. As in Southern Spain, all those of the better class enclose a *patio*, or courtyard, partly occupied by tropical trees or flowering shrubs. Fronting the street, or the *plaza*, a long projecting balcony, enclosed with glass, enables the inmates to enjoy that refuge from absolute vacancy which is afforded by gazing at the passers-by, and which seems to supply the place of occupation to much of the population even in Southern Europe.

With scarcely an exception, the numerous churches are vile examples of debased renaissance architecture, fronted with stucco ornamentation in great part fallen to decay. Not long before our arrival, I believe under the Chilian administration, they had been all freshly covered with whitewash, cut into rectangular spaces by broad bands of bright blue. In the streets near the great *plaza* there was much apparent animation during the day; but the shops were closed an hour before nightfall, and after dark the city was hushed into unnatural silence. The fair *Limeñas*, as to whose charms travellers have been eloquent, and who used to throng the public drives and walks towards sunset, were no longer to be seen. To exhibit themselves would be to display indifference to the misfortunes of their country. Some might be observed, indeed, during the morning hours, plainly dressed in black, going either to church or on some business errand; but they were so closely wrapped up in a *manta* as to be completely disguised.

CHOICE OF A ROUTE TO THE ANDES.

On landing in Peru, the one question which completely engrossed my mind was whether or not it would be possible for me, in the present state of the country, to reach the upper region of the Andes.

To a naturalist this great chain must ever be the dominant feature of the South American continent. To its structure and its flora and fauna are attached questions of overwhelming importance to the past history of our planet, and, however little a man may hope to effect during a flying visit, the desire to gain that degree of acquaintance which actual observation alone can give becomes painfully intense. I was aware that what had formerly been a long and rather laborious journey had of late years been reduced to a mere excursion by the construction of two lines of railway, leading from the sea-coast to the upper region. That which, if free to choose, I should have preferred starts from the coast at Mollendo, and, passing the important town of Arequipa, traverses the crest of the Cordillera, and has its terminus at Puno, on the Lake of Titicaca, in the centre of the plateau which lies between the two main ridges of the Andes. The region surrounding this great lake, which here divides Peru from Bolivia, must offer objects of interest only too numerous and too engrossing for a traveller whose time is counted by days. Although the level of the lake is some 12,800 feet above the sea, the peaks of Sorata rise above its eastern shores to a further height of nearly 10,000 feet; and lake steamers give access to most of the inhabited places on its shores – no slight matter when it is remembered that the lake measures more than a hundred miles in length.

The second line, which, starting from the city of Lima, is carried nearly due east along the valley of the Rimac, was designed to open communication by the most direct route between the capital and the fertile region on the eastern slopes of the Andes – called in Peru the *Montaña*– as well as with the rich silver region of Cerro de Pasco. The crest of the Cordillera, or western ridge of the Andes, is scarcely eighty miles from Lima in a direct line, but the most practicable pass is somewhat higher than the summit of Mont Blanc. The road was to pierce the pass by a tunnel 15,645 feet above the sea-level, and thence to descend to the town of Oroya on the high plateau that divides the two main ridges. As the line was laid out, the distance from Lima to the summit-level was only 97 miles, and that to Oroya 129 miles.

Considered merely as engineering works, these lines, which owe their existence to the enterprise of an American contractor and the skill of the engineers who carried out the undertaking, may fairly be counted among the wonders of the world. The Oroya line, the more difficult of the two, unfortunately remained unfinished. Although the loans contracted in Europe by the Peruvian Government more than sufficed to defray the cost of all the industrial undertakings that they were professedly intended to supply, it is scarcely necessary to say that a large portion disappeared through underground channels, leaving legitimate demands unprovided for. The stipulated instalments due to Mr. Meiggs, the great contractor, remained unpaid, and, in the midst of the difficulties in which he was thus involved, his death put a final stoppage to the works. The line had been completed and opened for a distance of about eighty miles from Lima, as far as the village of Chicla, 12,220 feet above the sea. From that time forward Mr. Meiggs devoted his energies to the boring of the tunnel at the summit, probably under the impression that if that were once finished the Peruvian Government could scarcely fail to provide the funds necessary to complete the line on either side.

UNFINISHED ANDEAN RAILWAY.

I had found it impossible to ascertain before leaving England what had been the fate of these magnificent works since the ravages of war had devastated the region through which they are carried. Various quite inconsistent stories had reached me through the passengers from Panama, Guayaquil, and Payta. Traffic, said some, continued on both lines just as before the war; traffic, said others, had been completely stopped by order of the Chilian authorities; others, finally, asserted that the Oroya line had been so damaged by either belligerent as to be rendered permanently useless.

Before I had been many hours on shore, I was able to get authentic information which relieved my mind from further anxiety. The southern line, from Mollendo to Puno, was open; but Arequipa, the chief place on the way, was still in possession of the Peruvians, who occupied it in some force. With permits, to be obtained from the commanding officers on both sides, it might be possible to go and return, supposing no fresh outbreak of hostile movements of the troops on either side. The news as to the Oroya line was even more satisfactory. The whole line was occupied by the Chilian forces, there being a detachment at Chicla, with outposts on the farther side of the pass. The line had been for some time closed to traffic, but had been re-opened a few days before our arrival. With a permit, to be obtained from the chief of the staff in Lima, there would be no difficulty in proceeding to Chicla.

My decision was speedily taken. Under the most favourable circumstances, the time necessary to reach Puno and return to the coast, with the not improbable risk of detention, was more than I could afford. Further than this, as Puno lies on the plateau remote from the mountains, I should see but little of the characteristic flora of the Andes, unless I could reach some place on the eastern shore of the Lake of Titicaca, whence access could be had to the flanks of the Sorata Andes.

Some description of the Lake of Titicaca which I had read as a boy still dwelt in my mind, and the memoirs and conversation of the late Mr. Pentland had long made the peaks of Sorata objects of especial interest to me. There could, however, be no doubt that the faint hope of beholding them which had lingered till then must be renounced, and I was too happy at the prospect of achieving a short visit to the more accessible part of the chain to have leisure for any keen regret.

DON PATRICIO LYNCH.

Having ascertained that the trains to Chicla departed only every second day, returning thence on the alternate days, I arranged to start on the 20th. During the two intermediate days, I had the opportunity of making several agreeable acquaintances. Sir Spencer St. John, the English minister, had lately returned to Europe, and the legation was temporarily under the charge of Mr. J. R. Graham, who had recently acted as *chargé d'affaires* in Guatemala. Among other kind attentions which I have to acknowledge, Mr. Graham was good enough to introduce me to Don Patricio Lynch, commander-in-chief of the Chilian forces in Peru.

The object of boundless admiration from his own followers, and of still more unmeasured denunciation from his enemies, General Lynch is undoubtedly the most remarkable man who has come to the front during the late unhappy war in South America. Like most of the men who have acquired military renown in that part of the world, he is of Irish extraction, his grandfather having settled in Chili early in the present century. Having served as a young man for a time in the English navy, he was promoted by the Chilian Government, some time after the outbreak of the war, to a naval command. The operations at sea had, up to that time, been on the whole unfavourable to Chili, and the successes which finally changed the aspect of the war by sea were largely ascribed to the energy and ability of Admiral Lynch. Passing from the sea to the land, he so much distinguished himself in various daring encounters with the enemy that he was finally promoted to the chief command of the Chilian forces in Peru, and at this time was virtually dictator, with absolute rule over the whole coast region occupied by the Chilian army.

However open to discussion might be the policy adopted by the Chilians towards the conquered country, there was a general agreement as to one matter of no slight importance. The population of Lima and the surrounding districts is composed of the most varied constituents – native Indian, negro, and the mongrel offspring of the intermixture of these with European blood, to all which of late years has been added a large contingent of Chinese immigrants. It is not surprising that, under inefficient administration, there should have arisen from the dregs of such a population a large class either actually living by crime or ready to resort to outrage as favourable opportunities might arise. On the other hand, the Chilian army, for which there was but a small nucleus of regular troops, had to be largely recruited from among the loose fish of the floating population of South America, and naturally included no small number of bad subjects, ready to make the utmost use of the license of war. For many years past the police of Lima was notoriously inefficient; robberies were frequent, and there were many spots in the neighbourhood of the city where it was considered unsafe to go unarmed even in broad daylight. It was not unreasonably feared that in such conditions the occupation of the city by the Chilians would have results disastrous for the safety of the numerous foreign residents and the peaceful citizens. It was through the energy and capacity of General Lynch that the apprehended reign of disorder was averted. An efficient police was at once established, speedy capital punishment was awarded in every case of serious outrage, and with stern impartiality a short shrift was allotted alike to the Peruvian marauder and the looter wearing Chilian uniform. It was admitted on all hands that the city had never before been so safe, while, at the same time, the ordinary municipal work of cleansing, watering, and lighting the streets and public places had been visibly improved under the stimulus of vigorous administration.

ORDER ESTABLISHED IN LIMA.

My reception by the Chilian general was all that I could desire. He at once expressed his readiness to assist my objects in every way, and carried out his promise by giving me a letter to the officer commanding the detachment at Chicla, with instructions to provide horses and guides and all needful protection for myself and my companion. I failed to detect in General Lynch any of the characteristics, usually so persistent, of men of Irish descent. The stately courtesy and serious expression, reminding one of the bearing of a Castilian gentleman, were not enlivened by the irrepressible touches of liveliness that involuntarily relieve even a careworn Irishman from the pressure of his environment. One particularity in the arrangements at head-quarters struck me as

singular; but I afterwards understood that it was merely the transference to Peru of the ordinary habits of Chili. The head-quarters of the general were fixed in the former palace of the Spanish viceroys. A sentry in the street paid no attention as, in company with Mr. Graham, I entered the first court, and it appeared that every one, or, at least, every decently dressed stranger, was free to pass. Through an open door we entered the first of a suite of large rooms, and advanced from one to another without encountering a human being, whether guard or attendant, until in the last room but one, seemingly by accident, a secretary presented himself, who at once ushered us into the cabinet of the general. In the case of any public man in Europe, to say nothing of the chief of an army of occupation constantly assailed by the fiercest denunciations, and left thus easy of access, some fanatic or madman would speedily translate the popular hatred into grim deed.

Among the acquaintances made in Lima, I must mention the name of Mr. William Nation, a gentleman who, amidst many difficulties, has acquired an extensive knowledge of the fauna and flora of Peru, and has observed with attention many facts of interest connected with the natural history of the country. After my return from Chicla, Mr. Nation was kind enough to accompany me in two short excursions in the neighbourhood of the city, and I am further indebted to him for much valuable assistance and information.

Soon after eight a.m. on the morning of April 20, I started from the railway station at Lima, in company with my friend W – , who was fortunately able to absent himself for some days. The country lying between the coast and the foot of the Cordillera appears to the eye a horizontal plain, but is, in fact, a slope inclining towards the sea, and rising very uniformly about seventy feet per mile.[6] This ancient sea-bottom extends for a distance of fully fifteen miles from Lima into the valley of the Rimac, which, in approaching the coast, gradually spreads out from a narrow gorge to a wide valley with a flat floor. At the same time the river gradually dwindles from a copious rushing torrent to a meagre stream, running in many shallow channels over a broad stony bed, until it is finally almost lost in the marshes near Callao. Its waters are consumed by the numerous irrigation channels; for it must be remembered that along the western side of the continent, for a distance of nearly thirty degrees of latitude, cultivation is confined to those tracts which can be irrigated by streams from the Andes. Keeping pretty near to the left bank of the Rimac, the railway runs between two detached hills, formerly islands when the sea stood a few hundred feet above its present level. That on the north side is called the Amancais, and another less extensive mass rises south of the river.

WINTER VEGETATION NEAR LIMA.

Throughout the greater part of the year these hills, as well as the lower slopes of the Cordillera, appear, as they did to me, absolutely bare of vegetation; but in winter, from June to September, slight showers of rain are not unfrequent, and the fogs, denser than in other seasons, rest more constantly on the hills, and doubtless deposit abundant night-dews on the surface. The seeds and bulbs and rhizomes awake from their long sleep, and in a few days the slopes are covered with a brilliant carpet, in which bright flowers of various species follow each other in rapid succession.

Alongside of the railway runs a broad road covered to a depth of a couple of feet with volcanic sand, with occasional loose blocks of stone. The struggles of the few laden animals that we saw in passing, as they toiled along this weary track under a scorching sun, suggested a thought of the wonderful changes which modern inventions have already effected, and are destined to effect in the future, throughout every part of the world. The track before our eyes was, until the other day, the sole line of direct communication between Lima and the interior of Peru. The passage of men and animals had in the course of centuries reduced the original stony surface to a river of fine sand, and by no better mode of transport had the treasures of Cerro de Pasco, and the other rich silver deposits of the same region, been carried to the coast to sap the manhood and energy of the Spanish settlers in Peru, and help to achieve the same result in the mother country.

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[6] The heights given in the text are those of the railway stations.

The American railway car, which is not without its drawbacks for ordinary travellers, is admirably suited to a naturalist in a new country. No time is lost in opening and shutting doors. Standing ready on the platform, one jumps off at every stoppage of the train, and jumps up again without delay or hindrance. I was able to appreciate these advantages during this day, and to add considerably to my collections by turning every moment to account. At first the vegetation was, of course, extremely scanty; but I was interested by finding here some representatives of genera that extend to the hotter and drier parts of the Mediterranean region, such as *Boerhavia* and *Lippia*.

Not far beyond the station of Santa Clara, near to which is a large sugar-plantation, the slopes on either side of the valley become more continuous, and gradually approach nearer together. The first trace of vegetation visible from a distance was shown by one of the cactus tribe, probably a *Cereus*, and as we ascended I was able to distinguish two other species of the same family.

VEGETATION OF THE RIMAC VALLEY.

At many points in the valley, always on slightly rising ground, shapeless inequalities of the surface marked with their rough outline all that now remains of the numerous villages that in the days of the Incas were scattered at short intervals.

As we advanced, the slopes on either side became higher and steeper, but were still apparently nearly bare of vegetation until we reached Chosica, about twenty-six miles from Lima, 2800 feet above the sea. At this place it was formerly the custom to halt for breakfast, but since the line has been re-opened, the only eatables to be found are the fruits, chiefly bananas and *granadillas*, which Indian women offer to the passengers.

Henceforward the line is fairly enclosed between the slopes on either hand, everywhere rough and steep, but, as is the nature of volcanic rocks, nowhere cut into precipices. The gradient becomes perceptibly steeper, being about one in thirty-three in the space between Chosica and San Bartolomé – about thirteen miles. Here the change of climate begins to be distinctly marked. It is evident that during a great part of the year the declivities are covered with vegetation, though now brown from drought, and they show the occasional action of running water in deep furrows and ravines. Here the engineers engaged on the railway first confronted the serious difficulties of the undertaking. Following the line from San Bartolomé to Chicla, the distance is only thirty-four miles, but the difference of level is 7317 feet, and the fifty-one miles between this and the summit-tunnel involve an ascent of 10,740 feet. The gradient is very uniform, never, I believe, exceeding one in twenty-six, the average being about one in twenty-eight. Some of the expedients adopted appear simple enough, though quite effectual for the intended purpose. Very steep uniform slopes have been ascended by zigzags, in which the train is alternately dragged by the locomotive in front, and then (the motion being reversed), shoved up the next incline with the engine in the rear. In one place I observed that we passed five times, always at a different level, above the same point in the valley below.

Among the more remarkable works on the line are the viaducts by which deep and broad ravines cut in the friable volcanic rocks have been spanned. The iron beams and girders that sustain these structures appear much slighter than I have seen used in Europe. In crossing one *barranca*, on what is said to be the loftiest viaduct in the world, I stood on the platform at the end of the car: there being no continuous roadway, the eye plunged directly down into the chasm below, over which we seemed to be travelling on a spider's web.

For a distance of about eight miles from San Bartolomé the railway keeps near to the bottom of the valley, between slopes whereon a distinct green hue is now visible, and some trickling rivulets are perceived in the channels of the ravines. On the opposite, or northern, slope are still distinctly seen the terraces by which in ancient days the industrious Indian population carried cultivation up the precipitous slopes to a height of more than fifteen hundred feet above the bed of the valley. For in this land, before the Spaniard destroyed its simple civilization and reduced the larger part to a wilderness, the pressure of population was felt as it now is in the southern valleys of the Alps. The fact that terrace cultivation commenced precisely in the part of the valley where we now find streamlets

from the flanks of the high mountains above, which might be used for partial irrigation, tends to show that no considerable change of climate has occurred.

ANCIENT INDIAN TERRACES.

Before reaching the Surco station (forty-eight miles from Lima, and 6655 feet above the sea) the road finally abandons the Rimac, and commences the seemingly formidable ascent of the declivity above the left bank. For some distance a projecting buttress with a moderate slope enabled the engineers to accomplish the ascent by long winding curves; but before long we reached the first zigzags, which are frequently repeated during the remainder of the ascent. The tunnels are frequent, but fortunately for the most part short, as the rate of travelling is necessarily slow, and the artificial fuel used gives out black fumes of a stifling character. A further change of climate, welcome to the botanist, was now very obvious. Although the soil appears to be parched, it is clear that some slight rain must recur at moderate intervals. Vegetation, if not luxuriant, finds the needful conditions, and in the gardens of Surco tropical fruits, such as bananas, cherimolias, oranges, and granadillas, are cultivated with tolerable success. Of the indigenous plants in flower at this season the large majority were *Compositæ*, chiefly belonging to the sun-flower tribe (*Helianthoïdeæ*), a group characteristic of the New World.[7] It was tantalizing to see so many new forms of vegetation pass before one's eyes untouched. Most of them were indeed finally captured, but several yet remain as fleeting images in my memory, never fixed by closer observation.

About one p.m. we reached the chief village of the valley, San Juan de Matucana, fifty-five miles from Lima, and about 7800 feet above the sea. The train halted here for twenty minutes, and we discovered that very tolerable food is to be had at a little inn kept by an Italian. Hunger having been already stilled, the time was available for botanizing in the neighbourhood of the station, and, along with several cosmopolite weeds which we are used to call European, I found a good many types not before seen. Owing to the accident of having left my gloves in the carriage, I unwisely postponed to collect one plant not seen by me again during my stay in Peru. This was a small species of *Tupa*, a genus now united to *Lobelia*, with flowers of a lurid purple colour, which is said to have the singular effect of producing temporary blindness in those who handle the foliage, and I had been assured by Mr. Nation that he had verified the statement by experiment.[8] We were here in the intermediate zone, wherein many species of the subtropical region are mingled with those characteristic of the Andean flora. Hitherto the most prevalent families, after the *Compositæ*, had been the *Solanaceæ* and *Malvaceæ*. These have many representatives in the Andean flora, but henceforward were associated with an increasing proportion of types of many different orders.

ASCENT FROM MATUCANA.

As we continued the ascent in the afternoon our locomotive began to show itself unequal to the heavy work of the long-continued ascent, whether owing to defects in construction or, as seemed more probable, to the bad quality of the fuel supplied. Two stoppages occurred, required, as we learned, to clear out tubes. A considerable ascent was then achieved by a detour into a lateral valley above Matucana, returning to the Rimac at a much higher level, as is done on the Brenner line between Gossensass and Schelleberg.

Up to this time the scenery had fallen much below my anticipations. Owing to the nature of the rocks, there was an utter deficiency in that variety of colour and form that are essential elements in the beauty of mountain scenery. A still greater defect is the entire absence of forest. Along the course of the Rimac bushes or small trees, such as *Schinus molle*, two *Acacias*, *Salix Humboldtiana*, and others, are tolerably frequent; but on the rugged surface of the mountain slopes nothing met the eye more conspicuous than the columnar stem of a cactus, or dense rigid tufts of what I took to be a

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[7] Of 138 genera of *Helianthoïdeæ* 107 are exclusively confined to the American continent, 18 more are common to America and distant regions of the earth, one only is limited to tropical Asia, and two to tropical Africa, the remainder being scattered among remote islands – the Sandwich group, the Galapagos, Madagascar, and St. Helena.

[8] In *Nature* for September 14, 1882.

Bromeliaceous plant, most probably a species of *Puya*. The sun had set, and darkness was fast closing round us when the train came suddenly to a standstill, and the intelligent American guard informed us that a delay of at least twenty minutes was required to set the locomotive in working order.

The accident was in every way fortunate. We had just reached the Puente Infernillo, by far the most striking scene on the whole route, rendered doubly impressive when seen by the rapidly fading light. The railway had here returned to the Rimac, and is carried for a short distance along the right bank. In front the river rushes out of a narrow cleft, while on either hand the mountains rise to a prodigious height, with a steeper declivity than we had as yet anywhere seen. With a lively recollection of the Via Mala, the gorge of Pfeffers, and other scenes of a similar character, I could bring to mind none to rival this for stern sublimity. The impassable chasm that seemed to defy further advance, the roar of the river in the deeply cut channel below, the impending masses that towered up above us, leaving but a strip of sky in view, combined to form such a representation of the jaws of hell as would have satisfied the imagination of the Tuscan poet. To a botanist the scene awoke very different associations. Before it became quite dark I had captured several outposts of the Andean flora, not hitherto seen. The beautiful *Tropæolum tuberosum*, with masses of flowers smaller, but even more brilliant, than those of the common garden species, climbed over the bushes. A fleshy-leaved *Oxalis*, the first seen of a numerous group, came out of the crevices of the adjoining rocks, and *Alonsoa acutifolia*, which I had never seen but in an English greenhouse, was an additional prize.

ASCENT FROM PUENTE INFERNILLO.

Night had completely fallen as we resumed our journey, and although my curiosity was much excited in the attempt to follow the course of the line, I utterly failed to do so. Watching the stars as guides to our direction, where these were not cut off by the frequent tunnels, I could only infer that we were constantly winding round sharp curves, at times near the bottom of a deep ravine, with the roar of a torrent close at hand, and soon after working at a dizzy height along the verge of a precipice, with the muffled bass of a waterfall heard from out of the depths. Even after I had travelled the reverse way in broad daylight, I remained in some doubt as to the real structure of this part of the line. So far as I know, the first application of a spiral tunnel in railway construction was on the line across the Apennine between Bologna and Florence, but the spiral is there but a semicircle; you enter it facing north, and emerge in the opposite direction at a higher level. A similar device has been more freely resorted to in the construction of the St. Gothard line; but on this part of the Oroya line, completed before that of the St. Gothard was commenced, the spiral, if I mistake not, includes two complete circles, at the end of which the train stands nearly vertically above the point from which it started. It is by no means altogether a tunnel, as the form of a great projecting buttress has allowed the line to be carried in great part along a spiral line traced upon its flanks.

Nearly two hours after sunset we at length reached the terminus at Chicla, very uncertain as to the resources of that place in point of shelter and food. We had had the pleasure of meeting in the train Mr. H – , a distinguished German statesman, who had travelled with us in the *Islay* on his way from California to make the tour of South America. He was accompanied by Baron von Zoden, the German minister at Lima. As their object was merely to see the railway line, they intended to return on the following morning; but meanwhile we resolved to confront together any difficulties that might arise.

The architecture of Chicla is remarkably uniform, the only differences being in the size of the edifices. Stone, brick, tiles, slate, and mortar are alike unknown. Planks are nailed together around a framework, the requisite number of pieces of corrugated iron are nailed to some rafters on the top, and the house is complete. After stepping from the railway car and scrambling up a steep bank, we found ourselves before the chief building of the place, a so-called hotel, kept by a worthy German whose ill fortune had placed him on the borderland, where for some time the place was alternately occupied by small parties of Chilian or Peruvian troops. Besides some rooms on an upper floor occupied by the people of the house, the hotel consisted of two large rooms on the ground floor, where food and drink

were supplied to all comers, with an adjoining kitchen. For such fastidious travellers as might require further sleeping accommodation than a cloak in which to roll themselves, and a floor on which to stretch their limbs, a long adjoining shed was provided. This was divided by thin partitions into four or five small chambers, each capable of holding two beds. Supper was before long provided; and when we afterwards learned the difficulties of our host's position, our surprise was excited more by the merits than by the defects of the entertainment.

MOUNTAIN-SICKNESS.

We had been assured at Lima that, on going up to Chicla, we should be sure to suffer from the *soroche*, by which name the people of South America denote mountain-sickness, familiar to those who ascend from the coast to the plateau of the Andes. Knowing the height of Chicla to be no more than 12,220 feet above the sea, and never having experienced any of the usual symptoms at greater heights in Europe, I had treated the warning with derision so far as I was personally concerned, though not sure what effect the diminished pressure might have on my companion. I have described elsewhere[8] my experience at Chicla, which undoubtedly resulted from a mitigated form of mountain-sickness, the symptoms being felt only at night, and passing away by day and in exercise. They were confined to the first two nights, and after the third day, during which we ascended to a height of more than two thousand feet above Chicla, they completely disappeared.

With regard to mountain-sickness, the only matter for surprise, as it seems to me, is that it is not more frequently felt at lower elevations, and that the human economy is able so readily to adapt itself to the altered conditions when transferred to an atmosphere of say two-thirds of the ordinary density, where the diminished supply to the lungs is aggravated by the increased mechanical effort requisite to move the limbs, and raise the weight of the body in an attenuated medium. Observation shows that the effects actually produced at great heights vary much with different individuals, and that in healthy subjects the functions after a short time adapt themselves to the new conditions. It is obvious that this process must have a limit, which has probably been very nearly attained in some cases.

In spite of some statements lately published, I am inclined to believe that the utmost limit of height compatible with active exertion will be found to lie, according to individual constitution, between twenty and twenty-five thousand feet. As regards our experiences at Chicla, the difficulty is to account for the fact that the effects produced while the body is at rest should disappear during active exercise; and whatever the nature of the disturbance of the functions, this was not accompanied by any discernible derangement of the respiration or the circulation. It appeared to me that the seat of disturbance, such as it was, was limited to the nervous system.

On the evening of our arrival we met at the hotel the commandant of the Chilian detachment, and on presenting my letter from the commander-in-chief, he was profuse in offers of assistance. It was speedily arranged that we should start on the following morning, to ride as far as the tunnel at the summit of the pass to Oroya, where I promised myself an ample harvest among the plants of the higher region of the Andes. When morning broke, after a sleepless night with a splitting headache, I found or fancied myself unfit for a hard day's work; and, my companion being in much the same plight, we sent at an early hour to request that the excursion should be postponed till the following day. By the time, however, that we had dressed and breakfasted, the troubles of the night were all forgotten. A new vegetable world was outside awaiting us, and we were soon on the slopes above the station, where, in the person of my friend W – , I had the advantage of a kind and zealous assistant in the work of plant-collecting.

FIRST DAY IN THE ANDES.

Deferring to a later page some remarks on the vegetation of the Cordillera, I need merely say that of this first delightful day the morning hours were devoted to the steep declivity of the mountain

[8] In *Nature* for September 14, 1882.

overhanging the left bank of the stream, while the afternoon was given to the less precipitous but more broken and irregular slopes on the opposite, or right, bank.

Having soon made the discovery that the supplies at Chicla were very limited, we had taken measures to procure a few creature comforts through the obliging conductor of the train, which left Chicla, in the morning, and was to return from Lima on the following evening. A far more serious deficiency was at the same time apparent. I had quite underrated the quantity of paper required to dry the harvest of specimens that I was sure to collect here, and no one but a botanist can measure the intensity of distress with which I viewed the prospect of losing precious specimens, and seeing shapes of beauty converted into repulsive masses of corruption, for want of the material necessary for their preservation. I addressed an urgent note to Mr. Nation, on whose sympathy as a brother naturalist I could safely count, telling him that unless I could find two reams of suitable drying-paper on my return, I should infallibly require accommodation in a lunatic asylum at Lima.

The scenery at Chicla is wild, but neither very beautiful nor very imposing. As in the lower valley of the Rimac, the slopes of the mountains are steep, but the summits are deficient in boldness and variety of form. Those lying on the watershed of the Cordillera, at a distance of fifteen or twenty miles, apparently range from seventeen to eighteen thousand feet in height, and on the first day of our visit showed but occasional streaks and patches of snow, while the sombre tints of the rocks exhibited little variety of hue even in the brightest sunshine.

Although the stream at Chicla is the main branch of the Rimac, its volume is here much reduced, not having yet received the numerous tributaries that fall into it between this place and Matucana. It is here no more than a brawling torrent, swelling rapidly after even a very moderate fall of rain, but prevented from ever dwindling very low by the snows, of which some patches at least remain at all seasons on the upper summits of the Cordillera. In a country without wood, and where the art of building in stone had made little progress, one of the most serious obstacles to any advance in civilization must have arisen from the difficulty of crossing the streams by which the upper ranges of the Andes are everywhere intersected.

ANDEAN SUSPENSION BRIDGES.

The art of constructing suspension bridges must have originated in the subtropical zone of Eastern Peru, where the abundance of climbing plants with long, flexible, tough stems supplied the requisite materials. These, being light and easily transported, were everywhere used in the valleys of the Andes to sustain hanging bridges, of which the roadway was formed of rough basket-work. The only change that has resulted from the introduction of European arts is that of late years iron wire is used instead of flexible *lianes* to sustain the bridges; but the roadway is still made of basket-work, which is rapidly worn by the feet of passing men and animals, and the natives have a disagreeable habit of stopping up the holes, not by mending the basket-work where this has begun to give way, but by laying a flat stone over the weak place. Being very slight and not nicely adjusted, these bridges swing to and fro under the feet of a passenger to an extent that is at first rather startling, but, as in everything else, habit soon makes one indifferent. Our first experience this afternoon was very easy, as the bridge connecting the station with the *pueblo*, or village of Chicla, was new and more solid than usual.

The little village, altogether composed of frail sheds, was occupied by the Chilian detachment of about two hundred men, posted here to guard the railway line. Four houses, larger than the rest, wherein the officers had established themselves, were adorned with conspicuous painted inscriptions worthy of the hotels of a great city. The *Fonda del Universo* informed the public that it contained "apartamentos para familias," and the rival establishments were no way inferior in the stateliness of their titles and the inducements offered. It must be recollected that Chicla is the first halting-place on the main, almost the only, line of communication between the coast and a magnificent region, as large as England, and teeming with natural resources – the *montaña* of Central Peru. Before the war the hostelries of Chicla were often crowded, and the accommodation doubtless appeared sumptuous

to the wearied travellers who had been contending with the hardships of the journey from the interior, and the passage of the double range of the Andes.

I have already said that the supplies at our hotel were somewhat scanty. Inquiries for eggs were met by the reply that the Chilian soldiers had killed all the poultry, and milk was not to be thought of, because the cows had all been driven to a distance to save them from the Chilians. But these were only trifling inconveniences. The experience of our German landlord was full of graver matter. A foreigner in the interior of Peru during this abominable war is placed between the devil and the deep sea. Having no one to protect him, his property is at the mercy of lawless soldiery; he is an object of suspicion to both parties, and his life is in constant peril. Our host owed to a fortunate accident that he had not been shot by a Peruvian party under the suspicion of having given information to the enemy. He was certainly no lover of the invader; but, like every foreigner in Peru, he looked forward with undisguised dread to the day when the Chilians should depart.

THE CONDOR AS OFFICER OF HEALTH.

If one had not recollected how very slowly and imperfectly the elementary rules of health have made way in Europe, it would have been hard to understand how men of education and intelligence, such as the great majority of the Chilian officers, should neglect the simplest precautions for preserving the health of themselves and their men. We had heard that the troops at Chicla had lost many men owing to a severe outbreak of typhoid fever, though the disease had recently almost disappeared. The cause was not far to seek. The ground all around the village was thickly strewn with the remains of the numerous baggage animals that had fallen from overwork, and the beasts that had been slaughtered by the soldiers. In South America the only sanitary officials are the carrion-eating birds. Near the coast the removal of offal is chiefly accomplished by the *gallinazo*, a large black vulture; in the Andes the condor takes charge of all carrion, and travels far in quest of it. It is likely that in the noisy neighbourhood of a detachment of soldiers the birds were shy of approach. If the remains had been dragged a short distance away from the village, they would have been quickly disposed of. As it was, the carcases were allowed to accumulate close to the sheds in which the men were lodged until they bred a pestilence. Things were mended, they said, at the time of our visit, yet, warned by vile emanations, I found the carcase of a horse lying close beside the *baraque* in which we slept; and it was only after energetic remonstrances that I succeeded in having it removed to some distance, where, doubtless, the condors made a savoury meal.

We were not curious to inquire too particularly what animal had supplied the material for our evening repast. It was enough that the skill of the Chinese boy who acted as cook had converted it into a very eatable dish. The work of the establishment seemed to be conducted altogether by two boys – the Chinese cook and a young German who acted as waiter. It was curious to notice that the intercourse between the two was carried on in English, or what passed as such. On many another occasion during my journey I observed the same thing. Throughout America, and I believe that the same is true in most countries out of Europe, English has become the *lingua franca*, the general medium of communication between people of different nationalities.

Having felt perfectly well all day, and inclined to believe that the discomforts of the previous night had arisen from some accidental cause, we had no hesitation in renewing the arrangement for an excursion to the *Tunnel en la cima*, and the Chilian commandant readily promised to send two horses, with a soldier who was to act as guide and escort, at seven o'clock on the following morning. Rather late, after some hours' work in laying out the plants collected during the day, I lay down to sleep, but in a short time awoke with a severe headache, accompanied by ineffectual nausea, the light supper being already digested. It was an undoubted case of mountain-sickness, which had to be borne through the sleepless dark hours until daylight summoned us to rise. As on the previous day, the operations of washing and dressing chased away the symptoms, and before seven o'clock we were ready to start. At half-past seven we began to lose patience, and despatched a messenger to ascertain the cause of delay. No answer coming, we resolved to go in quest of the promised steeds, and, shouldering the

impedimenta, proceeded across the stream to the *pueblo*. We soon discovered that no order had been given the night before, and that the commandant had not yet made his appearance. The messenger had not ventured to awake him, and thought it safest to await events. Having discovered the high-sounding name of the "hotel" where he lodged, I lost no time in proceeding to the double-bedded room shared by our commander with a brother officer, and rousing them both from sleep. Profuse excuses in excellent Spanish, with a promise that not a moment should be lost, were but a poor salve for my growing impatience, though policy required some faint effort at politeness, which had to be maintained through what seemed intolerable and interminable delays, until we at last got under way at ten o'clock.

NATIVE INDOLENCE.

It was indeed aggravating to find an excursion, to accomplish which any naturalist would gladly traverse an ocean, maimed and curtailed by the indolence which is the curse of the American Spaniard. One circumstance, indeed, helped to moderate the keenness of my disappointment. Rather heavy rain had fallen throughout the night, and the mountains about the head of the valley, previously almost clear of snow, were now covered pretty deep down to the level of about fifteen thousand feet. I already judged that it would be difficult, starting so late, to reach the summit tunnel, if sufficient time were to be reserved for botanizing. With snow on the ground the vegetation would be concealed, and the chief interest of the expedition lost, so that I readily made up my mind that we should not attempt to reach the summit of the pass.

We had not gone far on the track when we came to a suspension bridge, over which our soldier-guide rode as a matter of course. Seeing the frail structure swing to and fro under the horse's feet, I confess that I felt much inclined to dismount and cross on foot; but in such cases one remembers that whatever men or animals are accustomed to do they are sure to do safely, and I rode on, admiring the judgment with which my horse avoided the weak places in the basket-work under his feet.

The track is well beaten, and in easy places broad and even; but here and there, where it climbs over some projecting buttress of rock, is rather rougher and steeper than I have ever seen elsewhere in mountain countries on a path intended for horsemen, excepting, perhaps, some choice spots in the Great Atlas. It was impossible to push on rapidly, for we overtook a succession of long trains of baggage-animals – mules, donkeys, and llamas – moving towards the interior at a rate of little over two miles an hour. As it was only in favourable places that it was possible to pass, our patience went through many severe trials.

At about thirteen thousand feet above the sea we passed two farmhouses, evidently constructed by European settlers, plain but neat in appearance, and the fields better kept than one could have expected in a spot so remote, each with a clump of well-grown trees of the Peruvian elder. Higher up the scenery was constantly wilder, desolate rather than grand, and with no trace of the presence of man until we reached Casapalta, a small group of poor sheds now occupied by an outpost of Chilian soldiers, nearly fourteen thousand feet above the sea.

ALPINE REGION IN THE ANDES.

We had now evidently reached the true Alpine region. At the head of the valley in front fresh snow lay on the flanks of the mountains where the dark rugged masses of volcanic rock were not too steep to allow it to rest, and the higher summits in the background were completely covered. The slopes near at hand were carpeted with dwarf plants thickly set, rising only a few inches from the surface. The only exception was an erect spiny bush, growing about eighteen inches high, with dark orange flowers, one of the characteristic Andean forms —*Chuquiraga spinosa*.

The guide seemed disposed to halt here, but we had not yet reached our goal, and we pushed on for about three miles, to a point about 14,400 feet in height, where it seemed judicious to call a halt. For some time the horses had begun to show symptoms of distress. The spirited animal which I rode panted heavily in ascending the gentle slope, and at last was forced to stop and gasp for breath every thirty or forty yards. Near at hand a slender stream had cut a channel through some rough rocks, and

promised a harvest of moisture-loving Alpine plants; and opposite to us, on the northern side of the valley, a wild glen opened up a vista of snow-covered summits, of which the more distant appeared to reach a height of about eighteen thousand feet.

It was now about one o'clock, and, our light early breakfast being long since forgotten, we hastily swallowed our provision of sandwiches formed of the contents of a sardine-box, which, flavoured with the pure cold water of the stream, seemed delicious. Although the sun which had shone upon us during the morning was now covered with clouds, and we were very lightly dressed, no sensation of cold was felt at this height, and I do not believe that the thermometer at any time during the day fell below 50°. Doubtless the feverish excitement of those unique two hours of botanizing in a new world left no space for sensitiveness to other influences. The mountain-sickness of the previous night was utterly forgotten, and no sensation of inconvenience was felt during the day.

Reserving some remarks on the botany of this excursion, there is yet to be mentioned here one plant of the upper region so singular that it must attract the notice of every traveller. As we ascended from Casapalta we noticed patches of white which from a distance looked like snow. Seen nearer at hand, they had the appearance of large, rounded, flattened cushions, some five or six feet in diameter, and a foot high, covered with dense masses of floss silk that glistened with a silvery lustre. The unwary stranger who should be tempted to use one of these for a seat would suffer from the experiment. The plant is of the cactus family, and the silky covering conceals a host of long, slender, needle-like spines, that penetrate the flesh, easily break, and are most difficult to extract. Unfortunately, the living specimen which I sent to Kew did not survive the journey.

THE CONDOR AT HOME.

At about three o'clock it was necessary to think of returning. Several precious plants had been passed on the way and remained to be collected, and it was only prudent to return to our quarters before night, which here falls so abruptly. Soon after we started along the descending track, a whirring sound overhead caused us to look up. Two magnificent condors swooped down from the upper region, and, wheeling round about forty feet above our heads, described a half circle, and, having satisfied their curiosity, soared again to a vast height, till they seemed mere black specks in the sky. Meanwhile my horse, fresh after the long halt, and apparently delighted at the prospect of returning to pleasanter quarters, broke into a gallop, and throughout the way it cost me some trouble to restrain his impatience.

As we drew near Chicla, there being yet half an hour of daylight, we dismounted and dismissed our guide with the horses, thus being able to secure several plants not seen elsewhere. One of these was a solitary plant of the common potato, growing in a wild place among dwarf bushes near the stream. I do not, however, attach any importance to the fact as evidence on the disputed question of the true home of a plant which in South America has been cultivated from remote antiquity. The valley of the Rimac has doubtless been a frequented highway since long before the Spanish conquest, and, as we know, the plant spreads easily in favourable conditions. As far as I know, all the evidence as to the plant being indigenous in Peru and Bolivia is open to suspicion, and the only part of the continent where it can be said to be certainly a native is Southern Chili and the sub-Alpine region of the Chilian Andes.

The excursion to the upper region apparently completed the work of acclimatization. We slept soundly, and no symptoms of *soroche* was afterwards experienced. When I sallied forth on the morning of the 23rd in quest of breakfast, which was made luxurious by a tin of Swiss milk received by the train from Lima, I found my friend W – conversing in English with a Chilian officer. This gentleman, introduced as Captain B – , the son of English parents, was about proceeding in command of a small detachment to occupy some place beyond the Cordillera. The number of Englishmen in the Chilian service is not small, and there is no part of South America where the conditions of climate, the habits of life, and the character of the people seem to be so well suited to our countrymen.

One of the sights of Chicla was the daily despatch of trains of laden animals towards the interior. In the opposite direction the traffic was very limited, for since the war the working of the silver mines about Cerro de Pasco has been suspended, and little of the produce of the montaña now makes its way to the coast. But, war or no war, the wants of the inland population, living in a region which produces nothing but food and raw material, must in some measure be supplied. There was nothing very new in seeing goods packed on the backs of mules and donkeys, but the llamas and their ways were a continual source of interest. If the body be somewhat ungainly, the head with its large lustrous eyes may fairly be called beautiful. They vary extremely in colour. The prevailing hues are between light brown and buff, but we saw many quite white, and a few nearly black, with a good many mottled in large patches of white, and dark brown. The legs appear weak, and the animal can bear but a light burthen. On the mountain tracks, the load for a mule is three hundred pounds, that for a donkey two hundred pounds, while a llama can carry no more than a hundred pounds; and when any one attempts to increase the load, the animal lies down and moans piteously. He seems, indeed, not yet thoroughly resigned to domesticity, and there is a note of ineffectual complaint about his bearing and about all the sounds which he emits. One morning I was so much struck by what appeared to be the wailing of a child or a woman in distress, that I followed the sound until, behind a rock, I discovered a solitary llama that had somehow been separated from his companions. The advantage of the llama in the highlands of Peru, where fodder is scarce and must often be carried from a distance, is that he is able to shift for himself. Where the herbage is so coarse and so scanty that a donkey would starve, the llama picks up a living from the woody stems of the dwarf bushes that creep along the surface.

HABITS OF THE LLAMA.

Supposing that most of the plants growing on the slopes around Chicla had been collected two days before, I expected to find it expedient to go to some distance from the village on the 23rd. But I had formed an inadequate idea of the richness of the Andean flora. Commencing with a ridge of rocks on the opposite side of the valley, only a few hundred yards from the ground before traversed, I found so many new and interesting forms of vegetation that at the end of three or four hours of steady work I had ascended only four or five hundred feet above the village, and I believe that ample occupation for a week's work to a collector might be found within one mile of the Chicla station.

As already arranged, we decided to return to Lima on the morning of the 24th of April. If other engagements had not made this necessary, the condition of my collections would have forced me to retreat. It was certain that without a speedy supply of drying-paper a large portion must be lost. As we were despatching an early breakfast, we were struck by the appearance of a tall, vigorous, resolute-looking man, booted up to the thighs, who had arrived during the previous night. He turned out to be a fellow-countryman, one of that adventurous class that have supplied the pioneers of civilization to so many regions of the earth. This gentleman had settled in the montaña of Eastern Peru, at a height of only about four thousand feet above the sea. His account of the country was altogether attractive, and it was only after entering into some details that one began to think that a man of a less cheerful and enterprising disposition might have given a less favourable report. The place which he has selected is only some twenty leagues distant from the river Ucayali, one of the great tributaries of the Maranon, which is destined hereafter to be the channel for direct water-communication between Eastern Peru and the Atlantic coast. At present the only obstacle to communication is the fact that the country near the river is occupied by a tribe of fierce and hostile Indians, who allow no passage through their country. The climate was described by our informant as quite delightful and salubrious, the soil as most fertile, suitable for almost all tropical produce, and many of the plants of temperate regions, and the supposed inconveniences as unimportant. Jaguars are, indeed, common, but the chief objection to them is that they make it difficult to keep poultry. Poisonous snakes exist, but the prejudice against them is unreasonably strong. No case of any one dying from snake-bite had occurred at our informant's location.

THE MONTAÑA OF PERU.

One drawback he did, indeed, freely admit. There was scarcely any limit to be set to the productive capabilities of the country, but, beyond what could serve for personal consumption, it was hard to say what could be done with the crops. He was then engaged in trying the possibility of transporting some of the more valuable produce of his farming to Lima. The journey had been one of extreme difficulty. In some of the valleys heavy rains had washed away tracks and carried away bridges, and he had been driven back to seek a passage by some other route. About one-half of his train of mules with their loads had been carried away by torrents, or otherwise lost; but our buoyant countryman, now virtually arrived at his journey's end, seemed to think the experiment a fairly successful one. He had received no news from England since the beginning of the previous November, so that one or two newspapers five weeks old were eagerly accepted.

The return journey from Chicla to Lima was easy and agreeable, but offered little of special interest. I noticed a curious illustration of the effects of the sea-breeze on vegetation even at a distance of thirty or forty miles from the coast. As we descended, I observed that the acacias which abound in the middle zone of the valley were densely covered with masses of the white flowers of a climbing *Mikania*, quite masking the natural aspect of the shrub. I thought it strange that this appearance should not have struck me while on my way ascending the valley. On closer attention, I saw that the *Mikania* was entirely confined to the eastern side of the acacia, so that the same shrub, looked at from the western side, showed no trace either of the leaves or flowers of the visitor. On reaching the Lima station, I was kindly greeted by Mr. Nation, who at once relieved my most pressing anxiety by telling me that I should find two reams of filtering paper awaiting me at my hotel.

CLIMATE OF THE PERUVIAN ANDES.

Having given in the twenty-second volume of the *Journal of the Linnæan Society* a list of the plants collected during my excursion in the Cordillera, it is needless to overload these pages with technical names, and I shall content myself with a few general remarks on the vegetation of this region, amidst which I passed a brief period of constantly renewed admiration and delight. In the first place, the general character of the flora of Chicla differed altogether from my anticipations, for the simple reason that the climate is completely different from what might, under ordinary conditions, be expected. I had seen reason to conjecture that, in ascending from the Pacific coast to the Cordillera, the rate of diminution of mean temperature would be less considerable than in most other parts of the world, but I was no way prepared to find it so slight as it really is. During the time of my visit, the mean temperature at Lima, 448 feet above the sea, was very nearly 70°, while the annual mean appears to be 66·6° Fahr.[9] The mean temperature at Chicla at the same season was estimated by me at 54°, with a maximum of 65·7°, and a minimum of 42°, and the first figure probably approximates to the annual mean. For a difference in height of 11,774 feet this would give an average fall of 1° Fahr. for 935 feet of elevation, or 1 °Cent. for 512 metres; whereas, as is well known,[10] the ordinary estimate found in physical treatises, resulting chiefly from the observations of Humboldt, would give for Equatorial America a fall of 1° Fahr. for about 328 English feet of increased altitude, or 1 °Cent. for 180 metres. This rate of decrease would give a fall of 36·6° Fahr. in ascending from Lima to Chicla, whereas, as we have seen, the difference is probably little more than one-third, certainly less than one-half, of that amount. It is, therefore, with some astonishment that the stranger, arriving in this region of the Cordillera, finds himself amidst a vegetation characteristic of the Temperate zone,[11]

[9] The only accurate information that I have found respecting the climate of Lima is contained in a paper by Rouand y Paz Soldan, "Resumen de las Observaciones Meteorologicas hechas en Lima durante 1869," quoted in the French translation of Grisebach's "Vegetation du Globe." Reduced to English measures, they give the following results: —There is reason to think that the temperature for July, 1869, given above was exceptionally low, and although the months during which fogs prevail are abnormally cool for a place within 13° of the equator, I believe that the thermometer rarely falls below 60° Fahr.

[10] See Appendix A, On the Fall of Temperature in ascending to Heights above the Sea-level.

[11] It is a curious illustration of the utterly untrustworthy character of statements made by unscientific travellers to read the following passage in a book published by a recent traveller in South America, who visited Chicla in November, the beginning of summer. He declares that the fringe of green vegetation "dwindles and withers at a height of nine or ten thousand feet;… while on the upper grounds,

and that many of the most conspicuous species are such as in mid-Europe require the protection of a greenhouse. Amongst the more attractive and characteristic of the Andean flora, I may mention five species of *Calceolaria*, *Alonsoa*, two fine *Loasaceæ* (one with large deep orange flowers and stiff hairs that penetrate the gloves, the other a climber with yellow flowers), several bushy *Solanaceæ*, and a beautiful clematis, which may hereafter adorn European gardens.

Along with many types of vegetation peculiar to the Andes, or more or less widely diffused throughout the Western continent, it was very interesting to a botanist from Europe to find so large a proportion of the indigenous plants belong to types which characterize the mountain vegetation of our continent. Of the genera in which the plants collected by me are to be classed, fully one-half belong to this category, and these genera include more than an equal proportion of species. I find, indeed, that fully sixty per cent. of the species in my collection belong to European genera, but that, with trifling exceptions, the species are distinct and confined to the Andean region. The reasonable conclusion is that the types which are thus common to distant regions must be of very great antiquity, and that the ancestors of the existing species must have spread widely at a very remote period of the world's history. Most of the plants in question belong to genera having very numerous species, of which it may be presumed that the parent forms possessed a strong tendency to variation.

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where sometimes rain is plentiful, the air is too keen and cold for even the most dwarfish and stunted vegetation to thrive."

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