WILEY

A Journey among the Great Andes of the Equator

Author(s): Edward Whymper

Source: *Proceedings of the Royal Geographical Society and Monthly Record of Geography*, New Monthly Series, Vol. 3, No. 8 (Aug., 1881), pp. 449-471

Published by: [Wiley](#) on behalf of [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

Stable URL: <http://www.jstor.org/stable/1800277>

Accessed: 14/06/2014 18:55

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

The Royal Geographical Society (with the Institute of British Geographers) and Wiley are collaborating with JSTOR to digitize, preserve and extend access to Proceedings of the Royal Geographical Society and Monthly Record of Geography.

<http://www.jstor.org>

PROCEEDINGS
OF THE
ROYAL GEOGRAPHICAL SOCIETY
AND MONTHLY RECORD OF GEOGRAPHY.

A Journey among the Great Andes of the Equator.

By EDWARD WHYMFER.

(Read at the Evening Meeting, May 9th, 1881.)

Diagram of Route, p. 512.

I LEFT England towards the end of 1879 to travel in the Republic of the Equator, for the purpose of exploring the Great Andes of that region, and with the object of investigating certain matters bearing on mountain-travel. One of the principal objects of the journey was to examine into the practicability of living at great elevations; but I have already, in another place, referred to that matter, and I do not propose to touch upon it here at all, beyond making one observation to correct misapprehension. By living for a considerable time at elevations of from 16,000 to 18,000 feet, and more especially by passing twenty-six consecutive hours at a height exceeding 19,000 feet, without sustaining inconvenience from the low atmospheric pressure which was then experienced, I concluded and believe that if it had been necessary for any purpose to mount several thousand feet higher, say to the height of 24,000 or 25,000 feet, we could have done so. But our experiences do *not* prove that any one could remain for a length of time at such an elevation as 24,000 feet, and unless this can be accomplished there is not the least probability, there is not indeed the possibility, that any one will ever reach, on foot, the summits of the highest known mountains. This is not merely a question of overcoming physical difficulties, it is a question of pressure; and it remains to be seen whether the human system can adapt itself to a pressure only *one-third* of that which we experience at the level of the sea.

Another of the principal objects of my journey was to compare the working of aneroid against mercurial barometers at great elevations, and also to find out how altitudes obtained by calculations based on the boiling-point of water compared with the indications of mercurial

NO. VIII.—AUGUST, 1881.]

2 G

barometers. As these matters will be discussed at length elsewhere, I propose to make only a few general observations upon them now, and to speak first in regard to aneroids.

Though it is well known that a single aneroid is worthless for giving absolute determinations of altitude, many persons employ these instruments under the contrary supposition. It cannot be too widely understood that aneroid barometers, besides almost always gradually acquiring considerable errors, are liable through a variety of causes to *sudden* increases in their errors. When a traveller is possessed of a number of aneroids it is possible for him to detect these sudden increases by comparing one against another; but this is not possible in the case of a person who has only a single instrument, and in consequence he may be, most likely will be, led into the perpetration of serious mistakes.

It occurred to me that, if a number of aneroids were carried, it might be possible to obtain decent approximations to the truth by taking means of the whole of those which remained tolerably constant together, and rejecting those which were widely apart; and to settle this point I took out eight aneroids of the best construction, which had been under trial nearly twelve months before my departure, and which were the pick of a number of others which had been expressly made for the journey. I will tell you now how those eight aneroids behaved. Upon leaving England they were well together, the greatest difference between them being about the eighth of an inch, or, more exactly, $\cdot 13$. The value of this difference at the level of the sea amounts to about 100 feet; and if the mean of the whole had been taken, there would have been but an infinitesimal difference between it and the reading of a standard mercurial. But by the time I arrived at Guayaquil this difference had increased to $\cdot 35$; on arrival at Guaranda (8900) it had still further risen to $\cdot 74$; at our first camp on Chimborazo (14,300) it had mounted to $\cdot 88$, and at our third camp (17,200) to 1.2 inch. These were the differences of those which held closest together, rejecting those which had clearly gone mad. They differed amongst each other at starting to the extent of 100 feet, and by the time we had risen to 17,000 feet this difference had increased to about *two thousand* feet. If you consider that these were not aneroids selected at random, but were the pick of a number which had been expressly constructed for the journey, I think you will feel that this experiment conclusively demonstrated the uselessness of expecting to obtain absolute determinations of altitude from any number of aneroids; and expensive as the experience was I do not consider it dearly gained, as it decided that matter, so far as I desire to pursue it, for once and all.

The best of all ways to settle whether altitudes can be deduced with accuracy from the indications afforded by the boiling-point of water would of course be to conduct a series of experiments on the boiling-point at positions the height of which had been determined with

scrupulous accuracy trigonometrically; but the opportunities of doing this at great elevations are not numerous, and such experiments can be performed at heights exceeding 16,000 feet in India alone.

The next best way is to compare them against the mercurial barometer, and as we had mercurials almost always with us, I took the opportunity to make experiments, with the result of finding that the boiling-point observations consistently yielded lower altitudes than the mercurial barometer, and I quote in illustration three of the highest stations at which water was boiled, namely, the summits of Cotopaxi, Antisana, and Cayambe.

The elevation of Cotopaxi by merc. bar. was	19,650
" " " boiling water	19,090
" Antisana by merc. bar.	19,335
" " " boiling water	18,714
" Cayambe by merc. bar.	19,200
" " " boiling water	18,600

For the sake of these experiments it was highly desirable that simultaneous observations should be made at the level of the sea at no very distant point, and I was fortunate enough to obtain the necessary co-operation. Upon being properly introduced at the Foreign Office, Lord Salisbury directed Her Majesty's officials in Ecuador to "afford me every aid and assistance," and these official instructions were sympathetically interpreted by Mr. Chambers, our consul at Guayaquil, who, at considerable personal inconvenience, read at 11 A.M. and 6 P.M., from December 1879 to July 1880, a standard mercurial which I left with him; and, by so doing, not only rendered me a great service, but enabled to be placed on record the range of the barometer at Guayaquil, which was in itself a matter of interest. Having now cleared away these extraneous matters, I next propose to indicate to you the routes which we traversed.

Leaving England on November 3rd, 1879, I arrived at Colon just as transit over the Isthmus was stopped for ten days in consequence of extraordinarily heavy rain. It would have done the heart of M. Lesseps good could he have arrived at the same time, to see that, whatever difficulties he might have to overcome on the Isthmus, he would at least be free from the want of fresh water—which was a serious consideration to him when directing the construction of the Suez Canal; but, as I had less interest in that matter, the detention would have proved wearisome to me had I not had the great pleasure to be in the company of one of the most amiable and accomplished of your Associates, who I hope will one day plant the British flag on the North Pole, towards which he has had the honour of carrying it farther than any other person—I mean Captain Albert Markham. I parted from him at Guayaquil, and then proceeded with as little delay as possible along with my two Italian mountaineers—the cousins Carrel—to Guaranda, and worked in the

neighbourhood of Chimborazo for four weeks. The younger of the Carrels being badly frost-bitten on that mountain, our operations were stopped in this district, and we went on to Machachi, as in that part I could work with a single man; and with him I ascended the mountain Corazon, lying to the west of the town, and subsequently made an abortive attempt to ascend Illiniza from the south. When the younger man was sufficiently restored we ascended Cotopaxi, remaining on the summit twenty-six consecutive hours, and before returning to Machachi also ascended Sincholagua, which is the principal of the less important peaks of that district. We then transferred ourselves to Quito, and speedily set out for Antisana, where on our first attempt we were discomfited and had to try again. When we had stood on *that* summit we returned to Quito, and next made a little excursion to Pichincha and ascended two of its peaks. Returning again to Quito, we (after the lapse of a few days) set out for a journey to the north, and upon this explored the great Equatorial mountain Cayambe, the scarcely heard-of peak called Sara-urcu (which gave us more trouble than any other), and the fine mountain Cotocachi, which is the dominating summit of *its* district. I then proceeded still farther to the north, to the towns of Ibarra and Carranqui, sending my two Italians back to Machachi, with strict injunctions not to show their faces again until they could show me the summit of Illiniza at the same time. Soon after I returned to Quito, broken-down and fit only for bed, they were able to present me with the highest rocks of Illiniza, having successfully accomplished their mission.

I remained at Quito for a month, in a very feeble condition, and then set out southwards; made a journey from Riobamba to Altar, but was unable even to see its summit whilst in its neighbourhood; and then, as time began to press, we made our way to Carhuairazo, which we ascended on June 29th, and continued round the western side of Chimborazo, making a second ascent of it on July 3rd, and then returned to Riobamba, and subsequently to Guayaquil through Guamote and the Bridge of Chimbo.

It is impossible, in the brief space which I have at my disposal this evening, to give you the faintest idea of the numerous points of interest which were presented on this journey; and I conceive that I shall be more likely to secure your attention if, instead of attempting to hurry over the whole, I group together a few remarks on some of the more prominent features of the country, and then, in conclusion, refer in some little detail to one of the journeys.

The Republic of the Equator is a country which has seldom been brought before this Society, and the information that there is in existence about it is derived from comparatively few authorities. It is bounded on the west by the Pacific, and is supposed to be bounded on the north by Colombia, on the south by Peru, and on the east by Brazil. On the

north and south they have some faint idea where the country terminates, but if you ask the great proprietors on the eastern side how far their properties extend, they will reply, "We shall be much obliged if you will tell us;" or, "As far as you can go to the east;" or, "We have no boundaries."

The only map of any size of Ecuador that can be procured is that by Villavicencio. It is highly imaginative, and delineates rivers flowing in the most delightfully symmetrical curves, and wonderful mountain ranges, such as the human eye has never looked upon. It is very generally ridiculed in the country, and it is well known that it is scarcely more than a bad copy of the earlier map by Maldonado, with alterations which in many cases are not improvements. In the remarks which I shall make to you I shall not follow its guidance, or the guidance of any previous traveller, and shall speak from personal observation alone.

From a geographical point of view, the country may be regarded as divided into three territories, namely, (1) all the land on the Pacific side of the Andes, (2) the high mountainous land of the interior, and (3) the less high land on the east of the second section, containing the head-waters of some of the tributaries of the Amazons.

The land on the Pacific side in the neighbourhood of Guayaquil, and some distance north and south, is extremely flat, and is of the nature of a delta, with numerous rivers and natural canals interlacing one another in such a way as to render it difficult to follow out any one in particular. The land here is so little elevated that in the rainy season a great part of it is submerged, and at that time you travel by canoe as far as Savaneta, and indeed somewhat beyond, over what during the rest of the year is the road to Quito.

When you quit this flat, outlying land, you find the slopes of the Andes rise without intermission, very steeply; and the abrupt manner in which the mountains commence to ascend from the flat land of the western region is not less noticeable than the extraordinary steepness of the slopes facing the Pacific. There is no route in the Alps which is regularly traversed in which you rise to so great a height in so short a lateral distance as you do in going from the village of Muñapamba (which is 1300 feet) to the top of the pass in the outer range, which is 10,400 feet above the sea-level. Dense and unpenetrated if not impenetrable vegetation covers the Pacific slopes up to the very crest of the ridge; giant trees rising straight upward mast-like for hundreds of feet, festooned with parasitic creepers, and enveloped at the base with a mass of tangled undergrowth, shut out the light, veil the path in obscurity, and limit the view to a few yards on either side. In the wonderful varieties of the objects which are noticed at every turn, the naturalist finds compensation for the deprivation of light and air; but the prolonged limitation of the prospect, the stagnation of the atmosphere, and the absence of the sun produce at length a craving for a less-confined

horizon; and I could not feel surprise at the remark of my men, when at last they heard the music of the mountain streams playing amongst the boulders, "Ah! now we begin to breathe!"

I used just now the term "outer range," and I should explain that before arriving at the (at this part) main range of the Andes, which culminates in Chimborazo, you pass over another and less important range which forms the western boundaries of the basin of the river Chimbo. Though the highest points of this outer range attain to 15,000 feet, and it extends some 40 miles from north to south, you may look for it on your maps in vain. The river Chimbo takes its rise from the slopes of Carihuairazo and Chimborazo, and on the whole has a north and south course, until it makes a sharp bend round the southern end of the outer range, and then falls into the river Yaguachi, and ultimately into the river Guayas.

Still proceeding towards the east, you next see, on the opposite side of the Chimbo, the range which in this latitude is the principal range of the Andes. South of Chimborazo, and as far as I have seen it, it has an average elevation of 15,000 feet, and contains a number of small peaks, none much higher than the others. Passes across it are not numerous. The lowest of them is perhaps that by which we descended on to the point called the Bridge of Chimbo, on our return, and this is a little under 12,000 feet above the sea. Next to the north, the pass which is most frequently used is that by which the road to Quito goes over the great sandy plain called the *arenal grande*, which is somewhat more than 14,000 feet above the level of the sea. Then, continuing to the north, comes Chimborazo, the highest of all the Andes of the Equator, separated on its northern side by a depression called Abraspungo from the mountain Carihuairazo—a mountain with several peaks, the highest not much short of 17,000 feet, resembling the Blumlis Alp in Switzerland, but planned on a grander scale. North of Carihuairazo this range sinks abruptly towards the basin of Ambato, which town, 8600 feet above the sea, enjoys a mild and agreeable climate. No mountains of prominence are seen to the west of it, and for 30 miles to the north there is nothing of great importance. You then arrive at Illiniza, rising above 17,000 feet, and in the next 35 miles to the north, almost in a line with the last-named, come Corazon, Atacatzo, and Pichincha. These are isolated mountains, connected, it is true, though not forming an uninterrupted range. The depressions between these are never so low as 10,000 feet; but on the north of Pichincha there is again a break in the continuity of the range made by the river Guallabamba, which at the northernmost of the two bridges marked on the diagram is only about 5600 feet above the sea. On the other side of this river the slopes of Mojanda commence to rise, and this mountain, though not touching the snow-line, covers, I believe, more ground than any other mountain in Ecuador, its slopes extending on its eastern side as far as the village of Cayambe. North of

Mojanda you have the two considerable mountains Imbabura and Coto-cachi, then there is the basin of Ibarra, scarcely more than 7000 feet above the sea, and still farther to the north the elevation of the country appears to increase.

Turning now to the south, we have first the great mountain Cayambe, covered with 5000 feet of snow and glacier, with the Equator just touching it. To its south-east there is a large glacier-bearing mountain called Sara-urcu, of which I shall speak more particularly presently; but then for a long distance to the south there is nothing very imposing until you arrive at Antisana, though the general elevation of the land is great—perhaps more than 13,000 feet. Antisana covers an immense extent of country, and has about the same amount of snow and glacier as Cayambe. To its south, so far as I could see, the mountains are small, and you have to return to the west for those of importance.

Pasocha and Rumiñahui are comparatively diminutive, their apparent rank being more due to the steepness with which they rise than to their absolute elevation; but Sincholagua is a fine peak of thoroughly Alpine character, with a summit as sharp as almost any of the Chamounix aiguilles. Nearly due south of it is Cotopaxi, the second in height of all the Andes of the Equator, and then you have again a long stretch of country containing nothing striking until you come to Tunguragua, a snow-clad summit over 16,000 feet, of very regular shape. South of this lies the basin of Riobamba, bordered on its east by Altar, an extinct volcano, whose crater round three-fourths of a circle presents some of the grandest pinnacles that can be seen in the world, the highest of the whole being not unlike the appearance which would be presented if the famous Aiguille de Dru were perched on the top of the Eiger. Still farther to the south the country is again of moderate elevation, and the only great peak visible—the active volcano Sangai, which is not much inferior in height to Altar—lies away to the south-east.

This brings me to the end of this tedious enumeration—an enumeration which would not have been made had there not been an object in view. It is taught at school, and it is set forth in maps, that the Andes in these latitudes are divided into two chains—parallel to each other, and running approximately north and south—which are termed the Western and the Eastern Cordillera. The French Academicians who worked in this region towards the beginning of the last century are responsible for this statement, but its popular acceptance is perhaps more due to Alexander von Humboldt than to them. Before venturing to call in question a statement which has taken a deep hold on the public mind, and may almost be termed an article of the geographical creed, I have thought it prudent and advisable to present my facts; and the conclusion which is to be drawn from these facts will be apparent if you cast your eyes upon the route diagram given in illustration of this paper. You

will see in a moment that there is not, and cannot be, such a thing as two lines of Cordilleras running parallel to each other. In the west, it is true, there are, as I have already pointed out, the four mountains Illiniza, Corazon, Atacatzo, and Pichincha, in a tolerably regular line. These must constitute part of the Western Cordillera. If you proceed north, you find yourself at once placed in the difficulty of not knowing whether to embrace Cotocachi, Imbabura, and Mojanda, or any one of them. Whether you do or do not embrace them, you will find it equally difficult to construct your second, or eastern, Cordillera. If you begin by placing Pasochoa and Rumiñahui in it, which two mountains *are* approximately parallel to the four on the other side, what will you do with the more important peaks of Sincholagua and Cotopaxi, and the still more important Antisana and Cayambe? To have extended the diagram farther southward would have made an illustration of inconvenient and unnecessary size. We had to draw the line somewhere, and we have drawn it at 1° S. latitude. Had the plan been extended farther to the south, the same thing would have been evident. I state unequivocally that there is no part of the whole country in which you will find two lines of Cordilleras even approximately parallel to each other, and possessing the importance which has, during this century, been attributed to them. I do not feel it incumbent on me to attempt to explain how this myth arose. The readiness with which it has been adopted by European geographers has no doubt been due to the absence of any map in which the positions of the great peaks have been correctly set down.

Passing now to the third territorial division—the country to the east of the Great Andes—we find there is still more to be learned. There is a route a little to the north of Antisana, through the village of Papallacta, not unfrequently traversed, which has been known for more than three centuries, and which, if not the exact route taken by the first discoverer of the Amazons, is something very like it; and there are one or two other routes more to the south, for which Riobamba or Baños are convenient starting-points, which have been less frequently followed; but the country between them is completely unknown to geographers, and it affords a nice field for young men of enterprise. I had some hopes that from the summits of the most eastern of the Great Andes we should have been able to gain some information about it. These hopes were not realised. On Altar, as you have heard, we could not even see the summit, and we ascended no higher than 14,000 feet. On Cotopaxi, during our prolonged stay, we saw nothing whatever towards the east; on the summit of Antisana we were completely enveloped in cloud; and on Cayambe, though we raced as hard as possible to endeavour to beat the clouds, and got on the top soon after 10 A.M., we were just too late, and again saw nothing whatever. The only point at which we learned anything was at our camp on Sara-urcu,

where we stopped several days, and from it we saw ranges to our south and S.S.E. running out towards the east, exceeding 14,000 feet in height, which must have been situated to the north of the river Napo. We got here into gneiss and mica-slate, and this was the only place at which we found such rocks.

I return now to the Great Andes of the interior. The whole of the mountains that we visited are or have been volcanoes. They are mountains which have been formed upon mountains—cones which have burst through and been piled up, on a basis of sandstone. In the neighbourhood of Chimborazo, and again in the ravine or quebrada of Guallabamba, sections of sandstone several thousand feet in thickness can be seen, sometimes fine and sometimes coarse, and always very loose and crumbling. Some of these old volcanoes, judging by the immense accumulations of glacier which now cover them, must have been extinct for centuries at least, and their rocks bear a close family resemblance to each other.

There are now only two volcanoes in Ecuador possessing such a degree of life as entitles them to be considered active ones, though there are two others, namely Tunguragua and Pichincha, which are frequently classed as such, and are anyhow not entirely extinct. I saw the summit of Tunguragua quite clear of cloud several times whilst in the neighbourhood of Ambato, and upon no occasion perceived either smoke or steam issuing from it, and the case was the same with Pichincha. But Sangai and Cotopaxi are both fully entitled to be considered active volcanoes, and are seldom at rest. Sangai has been seen by few persons, either European or Ecuadorian, and I only saw it when we were encamped upon Chimborazo at a height of 17,300 feet, and then only in the early morning. We *heard* it frequently before this, first of all when we were established at Guaranda, not less than 40 miles away, and its detonations were remarkably sharp and distinct, and were sometime sufficiently loud to make us start. We scarcely ever heard them except in the morning, but I do not think it should be inferred that they occurred only at that part of the day, and that the travelling of the sound was impeded by the clouds which were invariably formed over the whole intervening country as the day advanced.

Seen from Chimborazo, Sangai presents the appearance of a regular cone, and it is a very fine mountain, though less stately and symmetrical than Cotopaxi. It has large snow-beds on the upper part of the peak, which die out before its apex is reached, and that is black, and is doubtless formed of slopes of fine volcanic ash. We saw scarcely any smoke issue from it, but at intervals of twenty to thirty minutes there were outrushes of steam, which shot up jet-like with immense rapidity to a height of 4000 or 5000 feet above the edge of the crater, and then spread out into a mushroom-like head, which was gradually drifted away by the wind. It is curious to state that, although there were no mountains intervening between us and Sangai, we scarcely ever heard any detonations from it

whilst we were upon Chimborazo, though at Guaranda, as I have already said, nearly 9000 feet lower, they were sometimes loud enough to startle us. As we were obliged to leave Ecuador at a fixed date, we found ourselves unable to make a journey to Sangai, to examine it more closely.

SANGAI, AS SEEN FROM AN ELEVATION OF 17,400 FEET ON CHIMBORAZO.

We were a long time in the neighbourhood of Cotopaxi, and frequently saw it both close at hand and at considerable distances. More or less smoke mingled with steam was always issuing from its crater, and this rolled out in a leisurely way, unlike the violence of the eruptions which proceeded from Sangai; in fact, it was difficult to believe that it could be a very dangerous volcano. Yet, as I have related in another place, we ourselves once witnessed at a distance of 65 miles an eruption of ash, which was projected 20,000 feet in the air, and poured out in such volume that at the distance of 65 miles it produced the effect of twilight soon after midday. But Cotopaxi has done far worse than *that*, and what seems most feared are the floods which generally roll away from it during its greatest eruptions. Ecuadorians, and perhaps others, think that the water proceeds from the interior of the mountain, in short is erupted. I believe nothing of the kind, and that these floods are the result of the cone becoming unusually hot and liquefying the glaciers which repose on it. For there are glaciers, and considerable ones, upon it; though they are, from being blackened and obscured by ash, quite imperceptible at a distance.

All the lavas on the northern and western sides of Cotopaxi that we saw were evidently of considerable age, from the amount of mosses and lichens which were growing upon them. We found amongst them,

moreover, at great altitudes, a variety of beetles, which is another indication that they are not very recent. Lower down, on the plain on the north-west of Cotopaxi, we found a beetle* which, it may be from the dearth of amusements in this neighbourhood, has the habit of standing upon its head. I found numbers occupied in this interesting pursuit; numbers more fallen over on their backs, kicking about, unable to regain their feet; and many lying dead upon their backs.

The mention of glaciers upon Cotopaxi naturally leads me to speak of the glaciers of Ecuador in general. As travellers of eminence have visited and published works upon this region, it is surprising to find that complete ignorance exists respecting its glaciers; yet that there is complete ignorance is evident from the statement made in the recently published article on Ecuador in the 'Encyclopædia Britannica,' in which it says that "the crater of Altar, surrounded by a steep and jagged wall of rocks, is remarkable as the bed of the only real glacier known to exist in the Ecuadorian Andes." I found, on Altar, larger glaciers *outside* the crater than that which was *inside* it; and I found others of large size upon Carihuairazo, Illiniza, Cotacachi, Sincholagua, Quilindaña, Cotopaxi, Cayambe, Sara-urcu, Antisana, and Chimborazo. The largest were upon the last-named four mountains; and I am able to offer a convincing proof of their existence by means of a photograph, an enlargement from a negative that I took at the height of 18,400 feet on Chimborazo, in which not only is a portion seen of the glacier which crowns that noble mountain, but it is possible to determine its thickness—a thing which it is seldom practicable with glaciers anywhere.

The manner in which I have to hurry forward entirely precludes me from entering into details respecting the glaciers, beyond saying that in general features they present no points of startling difference from the glaciers of Europe. Although on several of the mountains which have been named the glacier-covered area is comparable to the amount on Mont Blanc, the Equatorial glaciers never descend to so low an elevation as one would expect from glaciers flowing out of such extensive reservoirs. I know no instance of an Ecuadorian glacier descending so low as 12,000 feet, and they generally terminate between 14,000 and 15,000 feet. Moraines are scarce upon them, for the reason that few rocks rise above them, and the evidences which moraines frequently afford of former great extensions of glaciers is consequently wanting. *Roches moutonnées* are rare, more perhaps on account of the ease with which most of the rocks disintegrate than from any other cause. On the south side of Chimborazo, in a valley in which there is now no glacier at all, was the only place in which I was certain of *roches moutonnées*, but this single instance proved that glaciers on that mountain have formerly extended lower down than they do now.

* A species of *Platycalia*, belonging to the same tribe as our cockchafer.

It may be stated, as a general rule, that crevasses in the lower parts of the glaciers of the Ecuadorian Andes are both smaller and less numerous than in corresponding situations in the Alps, and this I take to be an indication that in the inferior parts of these glaciers the rate of motion is less rapid than in the Alps. But in the higher regions they are frequently of enormous size, and we never anywhere had seen greater—if indeed so large—crevasses as we encountered on the upper part of Antisana, where some were at least $\frac{1}{4}$ to $\frac{1}{3}$ mile long, 300 feet deep, and 50 to 60 feet across.

Upon the whole, I think that the glaciers are least extensive on the *western* sides of the mountains which have been enumerated, but I speak on this point with some hesitation, as I have not in several cases seen completely round them. It is only what might be expected in a country where vapour-laden easterly wind so largely preponderates. True east wind is, however, rare in comparison with north-east and south-east, which outweigh all the rest. Charged with vapour from the Amazonian cauldron, these winds are almost ceaselessly blowing against the opposing sides of the Great Andes, and depositing their moisture in the form of fine snow or hail. In the frequency with which it will be remarked that our ascents were made from the west, there is an illustration of our frequent inability to see anything through the clouds which enveloped the other sides. In *force* the winds were not remarkable. There were only two occasions—namely, on the summit of Cotopaxi, when the tent was occupying a very exposed position, and once at the second camp on Chimborazo (16,500 feet)—on which we were in danger from wind, and on these two occasions it blew in squalls with great ferocity, and we were afraid to venture outside the tent lest the wind should get inside and blow our habitation to tatters. It seems that we must regard as a fiction the celebrated wind which, “veering for a moment, gives the traveller a side blow and unhorses him,” for on the whole we did not find wind in the Andes stronger than it is in Great Britain.

Though there seems to have been much exaggeration in respect to the force of the wind, there does not appear to have been any touching thunderstorms, and it is almost impossible to speak in too extravagant terms of the highly electrical condition of the Equatorial Andes. On no single occasion when we were at considerable elevations were we free from storms of greater or less severity. The whole air seemed saturated with electricity, and discharges might be determined at any moment. I think that the stray, occasional flashes which sometimes glared out between us and an intervening ridge, followed by a solitary roll, set us thinking more than the grand displays when the whole sky was *filled* with fiery darts, and crash after crash pealed out without intermission; though I never shall forget the occasion when on the top of Sincholagua, and close to the summit, on a narrow ridge of icy snow in which we were cutting footsteps, a ridge so steep and narrow that the merest

touch might have tumbled us over on one or the other side, we were surprised by a storm, which commenced without premonition, and in a few seconds raged above, below, and around us, with a fury which made us quiver, and maintained a ceaseless roll, as flash after flash darted across our ridge, and others struck, or appeared to strike, the rock pinnacles beneath us. With our axe-heads hissing, and not knowing whether it was more dangerous to go down or up, we at length went forward, snatched a few rocks from the immediate top, and then fled, scarcely daring to look behind, and escaped in safety though astonished to find ourselves alive.

There is in consequence a blank in my column of heights in the accompanying table.* This sets forth the names of the mountains we ascended, the temperatures we enjoyed on their summits, and the elevations which are assigned to them—in one column by myself and in the next by the Doctors Reiss and Stübel. Now, first as to temperature. It is well known that in the towns in the interior of Ecuador there is a very small thermometric range, and this fact is often held up for admiration in geographical works. I do not myself profess entire admiration for it, for the incomparable—some persons say, the *abominable* laziness of the Ecuadorians has an intimate connection with the much-admired equality of climate, which renders it almost certain that to-morrow will be like to-day. They therefore put off doing everything until to-morrow, and when to-morrow arrives, until the next day, and so on. I think, however, that the thermometric range is larger than is generally stated. In a communication from Dr. Jameson, published just twenty years ago by this Society, it was stated that at Quito the thermometer never rises above 64° or sinks below 46°. He evidently refers to the Fahrenheit scale. In the bulletin which professes to be issued from the Observatory at Quito, I see it is stated that in the twelve months between December 1879 and November 1880, the lowest minimum was 3°·5 Cent., and the highest

* TEMPERATURES and HEIGHTS of MOUNTAIN SUMMITS in ECUADOR.

Ascent.	Name of Mountain.	Temperature on Summit.	Height in Feet.	
			Whymper.	Reiss and Stübel.
Jan. 4, 1880	Chimborazo	Fahr. 21°	20,517	20,703
Feb. 2, "	Corazon	37°-43°	15,871	15,801
" 18, "	Cotopaxi	13°-21°	19,550	19,498
" 23, "	Sincholagua	..	..	16,365
Mar. 10, "	Antisana	44°-60°	19,260	18,885
" 23, "	Pichincha	46°	15,918	15,706
Apr. 4, "	Cayambe	32°-41°	19,200	19,161
" 17, "	Sara-ureu	43°-55°	15,500	..
" 24, "	Cotacachi	36°	16,289	16,293
June 29, "	Carhuairazo	38°-42°	16,480	16,752
July 3, "	Chimborazo	15°-20°	..	..

maximum 24° Cent. This would make the annual range exceed 20° Cent., which is a much larger amount than that stated by Dr. Jameson. These temperatures only refer to the city of Quito (9350 feet above sea-level), and what I desire to draw your attention to are the temperatures which were observed at much greater heights.

The lowest minimum observed during the whole of our journey was 19° Fahr. below freezing-point. This was the minimum of the night of February 18–19th, which was passed on the summit of Cotopaxi. The highest maximum observed during the whole journey was $75^{\circ}\cdot5$ Fahr., at the bottom of great Guallabamba ravine, at 2.30 P.M. on March 27th. There was therefore only a difference of $62^{\circ}\cdot5$ Fahr. between the greatest heat and the greatest cold experienced whilst we were in the interior. This is only about the range of the thermometer at London. But there were occasions on which considerable differences occurred in short periods. On one occasion on Chimborazo there was a range of 50° in three hours; and the most remarkable entry that I have in my journals in respect to temperature relates to Antisana, on the summit of which mountain we remained nearly two hours, in the shade and with a perfectly calm atmosphere the whole time, and yet the thermometer ranged from 44° to 60° , or eleven degrees higher than the greatest temperature that we experienced during three days at the hacienda of Antisana, which was 6000 feet lower down.

These extraordinary temperatures (which are quite improper, and contrary to our preconceived notions as to what ought to occur on the top of a snow mountain 19,000 feet high) interpose a difficulty in the calculation of the barometric observations, which has been felt by Mr. Ellis, of Greenwich Observatory, who has favoured me by entirely re-computing them; yet the results obtained by him and entered under my name in one column are perhaps more closely in accordance than might be expected with the results of Reiss and Stübel, which were obtained by an entirely different method. Our barometric determinations of the height of the towns in the interior closely agree, and for the height of Quito, at which place both of us amassed observations, we differ only to the extent of three feet, their results being 9350 and Mr. Ellis's 9353 feet.

The altitude in which you will take perhaps the greatest interest is that of Chimborazo, and in respect to that you see we differ to the extent of 186 feet. Villavicencio, twenty years earlier than Reiss and Stübel, stated the height to be 21,067 feet; Humboldt, forty years still earlier, made the height 21,424 feet; and the Spaniards associated with the French Academicians, in their book published at Madrid in 1748, made the height 21,611. Now it would seem from this that there is distinct evidence Chimborazo is sinking, for the farther we go back the loftier has it been.

There are, however, other persons who have measured the mountain,

namely the French Academicians who were associated with the Spaniards, and on turning to their determination it is curious and interesting to find that it was 20,581 feet, or only 64 feet different from my own. It is perhaps rather cruel to inquire what value we are to attach to the results of observers who differed amongst each other more than 1000 feet over the height of a single mountain, the French making it 1030 feet less than the Spaniards, but it is pretty obvious that both cannot have been right; and as I find that the determinations of the French Academicians accord with Mr. Ellis's more closely than any other, I pin my faith to them.

This leads me to say a few words respecting the work of the French Academicians in the neighbourhood of Quito, which I venture to hope will be interesting to you. Most of you are aware that, in consequence of discussions which had arisen as to the figure of the earth, the French Academy of Sciences, at the beginning of the last century, determined to send out two expeditions to measure arcs at a great distance apart. One expedition went to the Gulf of Bothnia, and the other, composed of MM. Godin, Bouguer, and La Condamine, to the Equator. They commenced their work on a plain to the north-east of Quito, measured there a base line about 40,000 feet long, and from the two ends of the base took angles to various stations, and ultimately carried a chain of triangles to the north beyond Ibarra, and to the south to Cuenca, extending over more than three degrees of latitude. Towards the end of their work they measured a base of verification near Cuenca, also about 40,000 feet long, and found its length by direct measurement differed from the calculated length less than *two* feet.

The toise that the French Academicians took out as a unit of measure was a bar of iron, and it has ever since been known as "the toise of Peru." Guyot, in his standard work, 'Tables Meteorological and Physical,' in a discussion of the various measures of length most generally used, says that "it may almost be called *the only common standard*, to which all the others are referred for comparison"; "the legal mètre is a legalised part of the toise of Peru, and this last remains the primitive standard."

As the measurement of the first base line (on which all the rest of the work depended) was intended to be, and apparently was, conducted with the greatest possible care, it was natural that the Academicians desired that it should be preserved, and that the two ends should be marked by monuments of a permanent nature. This matter had, in fact, been discussed and settled before the observers left Paris, and on the spot La Condamine specially charged himself with directing the erection of two pyramids, one at each end of the base.

In a scarce pamphlet, evidently written though not signed by him, he recounts the difficulties that he experienced in this matter, —how he fixed the centres of the pyramids most accurately over

the two ends of the measurement; how he had to make his own bricks, which he took care should be of a different size from those usually used, so that there might be no temptation to pull the monuments to pieces for the sake of their materials; how he had to construct a canal two leagues long to bring water for making mortar; and how stones had to be sought for and transported long distances on mule-back—this part of the business alone, he says, occupying several months, as a single stone often made a load. Then, in the case of the pyramid at the northern end, he found there was no solid foundation, and he had to create one by pile-driving, to search for wood fit for the piles, to bring workmen from Quito to fashion them, and to get them driven, and how the workmen ran away before the work was done. But *the* thing above all others which gave him most trouble was finding, dressing, and transporting suitable stones for the inscriptions. These stones were quarried in a ravine some hundreds of feet deep, and had to be hauled out by ropes, which had to be specially made, and then at the last moment the ropes broke, one of the stones was dashed to pieces, and they had to begin over again.

When at last all was complete, then there was infinite worry over the *inscriptions*, for the French Academicians had associated with them two Spanish naval gentlemen, who took exception to the phraseology, for the sake of their royal master, and for themselves, &c. &c. At last all was settled and finished, and La Condamine returned to Paris, arriving in 1745, after an absence of *ten* years, no doubt finding consolation in the thought that he had done a splendid piece of work, which could be referred to by generations to come by means of these monuments.

But towards the end of 1747, he heard casually that orders had been given by the Court of Spain to erase these pyramids, and this order was actually carried out before he had time to interpose. In the pamphlet to which I have referred he bemoans their fate, and recapitulates the details of their construction in a way which will almost raise a smile with those who do not know the country; but so little is this country changed, that the account reads like a narration of operations which have just been conducted, rather than a relation of things which happened a century and a half ago. He especially laments the supposed destruction of his two great stones for the inscriptions, but concludes in the spirit of a true man by declaring that all these things are of no importance in comparison with the loss of the measure of the base: "that length, which I had taken so much trouble to preserve, is now lost for ever."

La Condamine heard that orders were subsequently given for the re-instatement of these pyramids, though he probably never knew whether they were actually re-erected. When I was in Quito I felt a strong desire to learn what was their present state, and to find out if possible whether they occupied the same positions as before. For some time inquiries were fruitless, but at length Señor Rebolledo, the proprietor of

the mountain Antisana, and one of the greatest landowners in the country, heard of them, and told me that there was in a farm at no great distance from one of his properties to the north-east of Quito, a stone which he believed was part of the original pyramid of Oyambourou, and invited me to go over to examine it. On the 15th of May last year, we rode over to his farm of Olalla, close to the town of Pifo, and on the next day went to inspect the stone. It was about four feet long and six inches thick, placed in the middle of one side of the courtyard, and was used as a mounting-block. There had been an inscription upon it, but it was completely worn out in the centre through the use to which it had been put. At its two ends some letters could still be made out, and going down on hands and knees to compare them with the description, which gives the original inscription line for line, I found that it was the very great stone which La Condamine had taken so much trouble to procure, and whose loss he had so pathetically lamented.

The pyramid which now approximately marks the southern end of the base is about 1000 feet distant from this farm, situated in a field of maize; and is neither the original pyramid nor the one which was erected subsequently, but is stated to have been put up some thirty years ago by a President of Ecuador, who so well understood the purpose for which it was originally designed that he moved it some hundreds of feet on one side, in order, he said, that *it might be better seen*. The traditional site of the earlier pyramids was pointed out to me, but I found no trace of them.

The pyramid at the northern end of the base was just visible as a speck of light, and we rode towards it, stopping, however, at a farm about half-way, where a French gentleman, Baron Gunzburg, had collected a party of friends. On the next day we all rode over to the northern end of the base, and found the pyramid which now stands there occupying just such a position as the original one is said to have done, at the very edge of the great ravine of Guallabamba, though whether it is anywhere near the original spot I am quite unable to say.

I have several times referred to the ravine, or *quebrada*, of Guallabamba, and it is one of the subjects upon which, in conjunction with the earthquake effects in general which are seen in Ecuador, I had intended to have spoken, and am obliged to omit in consequence of want of time. In Ecuador the term *quebrada* is employed for almost everything, from a ditch by the side of a road up to a valley of considerable size. In many countries the *quebrada* of Guallabamba would be reckoned a large valley, for it is, in round numbers, 3000 feet deep, and many miles long. In crossing it on March 27th, on our way to the north, we found that at the point where the descent commences it was 9306 and at the bottom 6470 feet above the sea. The surface of the country hereabouts is remarkably flat, and it was this which tempted the Academicians. In the centre of this plain you come to the *quebrada*, which is totally

unsuspected until you arrive at its very edge, and then you find the surface parted, much as it might be if you could take up the crust of the earth in your hand and break it like a biscuit. The country to the north for a long distance is seamed and fissured in all directions by these earthquake ravines, and we traversed them on our way to Sara-urcu, the mountain about which I am about to speak.

This mountain, which has scarcely been heard of in England, was referred to by Villavicencio in his book as 17,400 feet high, though whether he had any foundation for that statement I have not been able to learn. Neither at Quito or elsewhere was I able to procure any information as to its whereabouts, beyond that it was situated somewhere about the Equator, and I started for it with no further information, though in possession of letters of introduction to Señor Espinosa, the proprietor of Cayambe, who, when he heard me mention the name, declared that the mountain (and all the country to the east) belonged to *him*, and that he would point out its direction.

When we started for the ascent of Cayambe, Señor Espinosa accordingly accompanied us to a height of about 14,000 feet, and pointed out a vague something in the clouds, which he said was Sara-urcu; but we did not see it until several days afterwards, and then it appeared only for a few seconds, just long enough for me to get an idea of its general direction. In those few seconds we saw, however, that we should in all probability be able to get up it, if we could arrive at its base.

This was the first thing to do, and before breaking-up camp on Cayambe, I sent two of my people in advance to prospect, to see if they could find another camping-place farther on. They reported that they had found *a regular palace, planted all round with shrubs*, and we accordingly transferred ourselves and all our animals to it on April 6th, finding on arrival that it was a solitary and deserted Indian hut in the midst of a primeval forest.

At this time I was ill with fever and other ailments, and went to bed in the hut during the 7th, 8th, and 9th, sending out on each day successive parties in search of a way. They all came back with most dismal reports. The animals, they said, could go no farther; there was an end to all paths or tracks, except occasional wild-beast tracks; there was nothing whatever to eat, and everything must be carried; there was no place to camp, the whole country was a dismal swamp; and everlasting rain was falling, so that although they supposed that they had been somewhere near Sara-urcu, they were quite unable to be sure. On discussion, we came to the conclusion that we must leave our tents behind, as we were not strong enough to carry both them, the wraps, and the food. Hence it was indispensable to find a place which would afford some little protection against weather and wild beasts, and on the third day they reported having found an overhanging rock which would answer sufficiently well.

On the fourth day—that is to say, the 10th of April—we made a forward move, leaving two men at the hut to tend our beasts, and keep up communications, half of our party going in advance, and the rest, including myself, waiting for the arrival of additional provisions from Cayambe village. These arrived late, and delayed us so much that we could not reach the next camping-place by nightfall, and had to camp in a swamp, on a spot where, if you stood still, you sunk up to your knees in slimy slush. This position was 13,000 feet above the sea, and during the greater part of the eleven hours' night sleet or rain was falling, rendering it well-nigh impossible to keep up a fire out of the sodden materials. For me, the men constructed a sort of floating bed, cutting down the reeds, and crossing and recrossing them, piling them up until they no longer sunk into the foul slime. For themselves they constructed smaller platforms of a similar description, and sat on their heels on them during the whole night, trying to keep up the fire.

On the fifth day we advanced and rejoined the others, having to pass through a country more difficult than anything we had hitherto encountered. The land was entirely marshy, even where the slopes were considerable; and upon it there was growing a species of reed or cane in such dense masses as to be well-nigh impervious. It was impossible to make any use of our machetas, for it would have taken several weeks' labour of our whole party to have cleared a track over a single mile. The only way of getting through it was by continually parting it with the hands, and as it was exceedingly stiff, and taller than the tallest man, it sprung back directly we let go, and shut us out from each other's sight. The edges of the leaves were very sharp and cut like razors, so that in a short time our hands were streaming with blood, for we were compelled every now and then to grasp them to save ourselves from sinking in the boggy soil. On this day we crossed the ridge dividing the eastern from the western rivers, and the streams we now met with flowed towards the Atlantic.

We joined the others in due course under an overhanging rock of mica-slate, which we afterwards found was known by the name of "Corredor Machai," or the hunter's refuge. It was almost the only spot in the whole district where it was possible to camp, and afforded good protection on one side, of which we were glad, as there were numerous tracks of bears, pumas, and other wild beasts round about.

At midday I sent away two men to advance provisions in the direction in which I supposed our mountain was situated, and they returned with a human skull which they had picked up not far away. "I know that skull," said one of the Indians who were with us, "it belonged to a man who went out here searching for quinine bark; there were twenty of them altogether, and four came back. This one laid down to sleep, and did not wake again." I sent back also some other of our men to bring up more provisions from the last camp.

On the sixth day I advanced with the Carrels and two natives to the spot where the food was placed the previous day, and left the rest at Corredor Machai to keep up communications with the former camp. On this day we had to descend to the bottom of a valley and remount on the other side, and whilst so engaged we saw a large black bear crossing our track, and going through the reedy ground right ahead as if it interposed no obstacle. We shouted to it, but it scarcely deigned to notice us, and only just turned its head aside for a moment and went straight on and vanished in a thicket of scrub. Tracks of wild animals were more numerous than ever here, and afforded us some assistance, as they had often trodden down the canes. We seldom on this day saw more than 200 yards in any direction, rain falling in a steady mizzle; and we encamped in the afternoon against a rock at the height of 13,700 feet, not knowing where we were, though believing that we were close upon Sara-urcu.

On the seventh day we remained at the same spot, making small excursions in various directions to try and find out where we were, discovering nothing, however, beyond a large glacier on our north, which we rightly judged proceeded from our mountain. The elder Carrel returned to camp in the course of the afternoon, saying, "Monsieur, just now I was over there, looking down at the glacier to try to find a way, when I heard a noise behind, and looking round saw two big bulls a few yards off, advancing with their heads down ready to pitch me over the precipice. I ran away up a rock, and they came after me, and one stood on one side and the other on the other, and when I tried to escape on one side they both came there, and when I tried the other side they both went there, but at last I escaped, and here I am, quite out of breath." "Monsieur," he said, "on my word of honour, they were as fat as butter, and skipped about like chamois!"

On the eighth day, as rain continued to fall without intermission, and we were sodden, without having the means of drying ourselves, we descended to Corredor Machai, leaving such things behind as we could venture to leave at the higher station.

Rain continued the whole day in a drizzle, which prevented us seeing any distance. The wind blew steadily from the east, though occasionally shifting to the north or south. We were evidently placed just at the meeting place of the winds blowing from the two sides, for in occasional openings which occurred towards Cayambe mountain we not unfrequently saw that that mountain was clear, through north-west wind blowing upon it, and keeping back the easterly drizzle in which we were enveloped. It was hard to keep up the spirits of my people. They all wished to return.

On the ninth day I remained at Corredor Machai all day, sending most of the people down to bring up food. It rained nearly all this day, and the next also until 5 P.M., when it cleared up a little, and showed us the

position of Sara-urcu. I at once secured its direction precisely by theodolite, and made a sketch. This was the only occasion on which we had seen the mountain so far, and we did not see it again until the day we were quitting the district.

Having now got the bearing of the mountain exactly, its doom was sealed, and 5.30 A.M. (daybreak) on the eleventh day the Carrels with myself and two Indians started, and by a forced march reached the summit of Sara-urcu by half-past 1 in the afternoon, never seeing the top until we got on it, trusting to the guidance of the compass alone during the ascent. But we did not trust to it alone for the descent, and in order that we might return the exact way that we came, we cut a bundle of tops from the reeds, and planted them one by one in the snow on the glacier, so that let the hail fall, or let the wind destroy our track, we had the means of making a quick return; and it was exceedingly pretty when coming down to see the manner, as sailors would say, in which we picked these up. One had not died out of sight before another began to loom into view, and we came down without the least stoppage of any sort whatever; though, being surprised by darkness before we could arrive at Corredor Machai, we had to pass another wretched night at the higher station.

On this ascent we found that Sara-urcu was not, as it had been reputed to be, a volcano. Its highest rocks were gneiss, and we had evidently got beyond the strictly volcanic region. We found its height to be 15,500 feet, or 1900 feet lower than is stated by Villavicencio; but though the least elevated of the mountains we ascended, we found it bearing some of the greatest glaciers, which I believe, although situated exactly upon the equator, descend to a lower level than any in Ecuador.

Our work accomplished, we left Corredor Machai on the twelfth day, stopped for a day of rest at the hut, and on the fourteenth day that this little journey occupied arrived again at Cayambe village, heartily welcomed by the inhabitants, who did not expect to see us return from that dismal country.

Previous to the reading of the above,

The PRESIDENT said that Mr. Whympers needed no introduction to the Meeting, his name being well known to this Society as that of one of whom Englishmen were proud. Long before he went to South America he had distinguished himself for his enterprise and perseverance in climbing many hitherto untrodden peaks, and he had shown the greatest skill and courage in the midst of dangers, besides proving himself an accurate observer and careful investigator of nature in her various aspects. All these qualities he had manifested in a still higher degree during his adventures among the giant Andes.

After the paper,

General Sir H. L. THUILLIER said, though he had never been at greater altitudes himself than 10,000 feet, he had been connected with those who had trodden the icy glaciers of the Himalayas at even greater heights than Mr. Whympers had reached in South America. He understood that that gentleman had ascended to

20,517 feet. No doubt that was an extraordinary feat, because the effects produced on the physical frame by such high altitudes were well known, such as bleeding from the ears and nose; but some of those whose duty it was to perambulate the Himalayas had planted the theodolite at a height of 21,575 feet, while a considerable number had stood upon peaks varying from 15,000 to 18,000 feet. One distinguished officer of the Trigonometrical Survey of India, Major Thuillier, who was present at the meeting, had himself taken observations at 17,500 feet. He would like to have heard from Mr. Whymper what the altitude of the highest mountains which he saw was. In India the mountains rose to 29,000 feet. What was considered the highest peak in the world was known as Mount Everest, being named after Sir George Everest, a former Surveyor-General of India, but it was to be regretted that the local name had not been retained. It was almost on the meridian of Calcutta, in Nepal and north-west of Darjiling, and was called Gaurisankar by the people in the neighbouring district. It was for many years traversed from east to west by the Great Triangulation, and the result of a great number of observations was to prove that its height was 29,002·75 feet. Lord Canning, who was at that time Governor-General of India, was extremely anxious to find a still higher peak, to be named after her most gracious Majesty; but though another had been discovered 28,278 feet, in Little Kashmir territory, and was still unchristened, but styled "K²" for the present, none had yet been met with higher than Mount Everest. He complimented Mr. Whymper on his splendid achievements in mountain climbing, and said the Survey of India would be glad of such a recruit.

The PRESIDENT, in proposing a vote of thanks to the author of the paper, said that Mr. Whymper had stated that one of his objects in visiting the Andes was to discover at what height it was possible to exist. This reminded him (the President) of Coleridge's argument between the suicide and nature, where the suicide said,—

"If the life be the question, and the thing sent to try,
And to live on be 'Yes,' what would 'No' be? To die."

It was only among poets that any description could be found resembling Mr. Whymper's account of his adventures on the marshy heights of Sara-urcu. It was more like Milton's description of Satan's journey through chaos than anything else he had ever read. In his previous lecture before the Royal Institution, Mr. Whymper gave a less scientific, and less geographically useful, but an extremely entertaining account of his adventures, with minute descriptions of the terrible sufferings endured by himself and his two gallant mountaineers from the Alps. His predecessor on the summit of Cotopaxi had seen nothing, but Mr. Whymper remained there twenty-four hours, determined to look about him and make observations. Chimborazo had long been considered the highest peak of the Andes, but that now appeared to be a mistake, because Mr. Whymper had informed him that in Peru or Bolivia, south of the equator, there were points which were probably two or three thousand feet higher. One thing was clear, that Mr. Whymper had made important corrections, which would be of great value to cartographers in drawing maps of the district. They must all feel proud that it was an Englishman who had scaled the heights of all these mountains. With the single exception of Cotopaxi, none of the mountains had been previously ascended. Those who knew most of the Andes would best appreciate the value of the additions which Mr. Whymper had made to our knowledge of that range.

Mr. C. R. MARKHAM said his experience of the Andes only embraced the Cordilleras of Peru and Chili, and he was personally unacquainted with the Andes of Ecuador. He had listened with great interest to Mr. Whymper's theory respecting the non-existence of two parallel chains in Ecuador. In Peru, however, the two

ranges were distinctly marked, one being generally of a volcanic character, and the other being fossiliferous to its highest summits. Mr. David Forbes had informed him that the loftiest mountains in Bolivia had Silurian fossils to their topmost heights. Mr. Whymper had stated that the peak of Sara-urcu (which meant *male maize*) was not volcanic. Possibly that might indicate a continuation of the Eastern Cordillera of Peru. Mr. Whymper appeared to have been informed that the President of Ecuador who ordered the restoration of the pyramids erected to mark the ends of the base measured by the French savans, placed them where they could best be seen instead of in the exact positions in which they were originally built. Don Vicente Rocafuerte, however, was well acquainted with the geodetic science of his time, and it was his intention and his orders, at all events, that the pyramids should be placed in their former positions. He was one of the most enlightened men who ever ruled in South America, a mathematician and good classical scholar, as well as a statesman. At present it is the fashion to depreciate South Americans, but it ought to be remembered that the South American Republics have produced men of great distinction as mathematicians, geographers, and botanists. At the present time, Don José Triana, of Colombia, is an eminent botanist, of European reputation, while our Honorary Associate Paz Soldan of Peru, Vidal Gormaz of Chili, and Moreno of Buenos Ayres are distinguished geographers.

Mr. ETHERIDGE said that Mr. David Forbes, whose observations had been alluded to by Mr. Markham, examined the geological structure of Peru and Bolivia in the years 1857-60, and brought home a remarkable series of fossils ranging from the Silurian to the Jurassic rocks. These fossils were examined by the late Mr. Salter and himself (Mr. Etheridge), the result of which was that twenty-five species were named. The Silurian fauna predominated and was observed by Forbes 25,000 feet above the sea at the summit of the Andes. These Silurian rocks occupied an area of 80,000 square miles. The Devonian formation was present also, many species from strata of that age having been collected. The carboniferous rocks ascend up to 15,000 feet in Bolivia, in the provinces of Arque and Oruro, and north of Lake Titicaca. These rocks are highly fossiliferous, containing many British species; besides these, Jurassic rocks extensively occur, with ammonites closely allied to our own species. The Jurassic series range from Chili through the Desert of Atacama.

Askja, the largest Volcano of Iceland; with a short Description of the Ódádahraun. By WM. GEO. LOCK.

Map, p. 512.

HAVING twice visited Askja (in 1878 and 1880), of which there is no account in English except the brief notice by Mr. Watts,* the writer is enabled to give a fuller and more detailed account of this remarkable volcano.

Slightly to the east of the centre of the island lies the Ódádahraun ("misdeed lava-desert"), the largest lava-desert in Iceland. According to the cartographer Herra Gunnlaugsson the Ódádahraun has an area of 1200 square miles, and it forms part of a fire-blasted uninhabitable wilderness of at least double that area, lying between the Jökulsá and

* In his paper in vol. xlv. of the Royal Geographical Society's Journal, and in his book 'Across the Vatna Jökull.'

H. Shandau, del.

Pub.^d for the Proceedings of the Royal Geographical Society, 1881.

Edw. Waller.