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Explorations in the Bolivian Andes

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those of the polar expeditions so often despatched or subsidized by the Government, while its national and representative character are emphasized by the Prince of Wales having become its patron and the Duke of York its vice-patron. I cannot conclude my address without warmly thanking the subscribers among the Fellows, and representing to those who have not yet subscribed how much the credit not only of the Society, but of the country, is involved in the provision of adequate funds for this great national enterprise.

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### EXPLORATIONS IN THE BOLIVIAN ANDES.\*

By Sir MARTIN CONWAY.

BEFORE proceeding to describe in briefest outline the results of my expedition to the Andes in 1898, let me express in the most emphatic manner my thanks to the Governments of Bolivia, Peru, and Chile, for the facilities they placed in my way. Armed with the kind recommendation of Señor Aramayo, the able Bolivian minister to this country, I was received by his fellow-countrymen with open arms, and all ways were made for me as smooth as it was possible to make them. Our honorary Fellow, Señor M. V. Ballivian, was my good genius in La Paz, where, moreover, in the much-to-be-regretted absence of any British diplomatic representative, I was kindly protected by the French *Chargé d'affaires*, M. de Coutouly, and the United States minister, Dr. Bridgman. The Peruvian Government admitted my baggage free of duty; whilst the Chilian Government placed at my disposal in the Straits of Magellan a steamer, which enabled me to make the explorations I desired. To our own diplomatic representatives, Mr. Gosling at Valparaiso and Mr. St. John at Lima, I owe very hearty thanks for their great kindness; whilst at Punta Arenas Mr. Meredith, our vice-consul, extended to me a warm hospitality, and gave me valuable help.

Accompanied by two Alpine guides, Antoine Maquignaz and Louis Pellissier, I left Southampton early in July, and voyaged by the Royal Mail steamer to Colon; crossed the isthmus of Panama, spending a week in that neighbourhood; then sailed down the west coast of South America to Callao, where I took the opportunity of a four days' halt to mount by the Oroya railway to the crest of the Andes, and obtain a glimpse of the snowy range in the neighbourhood of the pass. From Callao I proceeded to Mollendo, and so by way of the Arequipa railroad to Lake Titicaca, that remarkable sheet of water fourteen times the size of the lake of Geneva and 12,600 feet above the sea, which is to be regarded merely as a remnant of a far greater inland sea now shrunk away. A steamboat took us down the lake, a voyage of 111 miles, on

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\* Read at the Royal Geographical Society, May 8, 1899. Map, p. 128.

a brilliantly clear and beautiful day. We passed the historic islands from which the Inca civilization is reported to have spread, and we saw the noble Mount Sorata rising in white splendour apparently from the waves. At Chililaya we transferred ourselves to a four-horse vehicle, locally known as a tilbury, and drove to La Paz by a good road which traverses the high level plateau called the Puna. During this drive of some 30 miles we were passing below the feet of the wonderfully straight range of snowy mountains called the Cordillera Real, whereof Mount Sorata forms the northern extremity, and Illimani, 64 miles away, the southern. It was this range that I had specially come to visit. I do not propose to give a merely chronological account of our doings during the four months we spent in this part of Bolivia. A concise statement of the general results of our work will probably be more interesting to this Society. I may remark that I triangulated the principal peaks of the range from Sorata to Illimani, and made a plane-table sketch survey of their western slope, and of the Puna and the valley of La Paz. But this map cannot be published at the same time as my paper, seeing that I hope to be able to correct and add to it by a second visit to the country.

The Cordillera Real is the backbone of Bolivia. To the east the mountains fall very rapidly to a low hill country and the fertile valleys which send their waters to the river Beni. I unfortunately saw little of this side of the range, and it is thither I hope to return. On the other side there lies the high plateau of which I have spoken, at a uniform altitude of 12,000 to 13,000 feet, from which the tops of low rocky hills here and there emerge. That this plateau was at one time submerged is obvious enough. The slopes that lead down to it from the main Cordillera are covered with immense accumulations of glacier-borne and water-rolled *débris*, the ruins of the range against which they lie. Evidence is plentiful that in ancient times the glaciers enveloped a large part of these slopes, and reached down many miles further than they now do, depositing the rocks that they carried into the waters of the ancient sea. What the limits of this glacier extension may have been, it is difficult now to estimate, for there are proofs that the glacier-deposited *débris* have been much torn about and rearranged by water. But a very minute examination would have to be made before the exact extent of this process could be estimated. In the immense pile of *débris* deep valleys were afterwards cut by the action of water, and into these valleys the glaciers in a second period of advance protruded their snouts, depositing moraines which can still be traced *in situ* as much as 4 or even 5 miles below the present limit of ice. One such glacier-cast was carefully examined by me near the foot of Mount Sorata. The terminal moraine now forms the dam of a large lake, 500 feet above the level of whose waters the two lateral moraines can be traced with perfect distinctness. At the north-west foot of the

same mountain, where the mule-track goes over from the Puna to Sorata town, the whole area is glacier-worn and encumbered with moraines; whilst in the deep Maperi valley, whose head lies against the north face of Mount Sorata—a valley now absolutely devoid of ice, and occupied up to the very foot of the mountain with almost tropical vegetation—the marks of glacier-action are of the most striking character. These are merely examples amongst the many that might be quoted from different parts of the range.

The climate of the plateau region is of importance in connection with its present physical formation. A great part of the year is completely rainless, but from the beginning of December till the end of March or April rain is precipitated very frequently and with great violence. During the remainder of the year the slopes and plains are swept by dry winds, and sometimes scorched by a very hot sun, so that, except at very high levels of perpetual snow, where bad weather lasts over a longer period, the surface of the whole country is dried and baked. In the rainy season mud avalanches fall down the slopes, gullies are deepened, every stream is in flood, waterways are ploughed in various directions in the plain, and all the rivers eat their way back. The great dryness of the land, when the rain begins, facilitates the rapid action of denudation, so that surface-modelling by water is perhaps as vigorously carried on here as it is in any part of the world.

That this is no modern development is proved by an examination of the range as a whole, for it is cut through, or is being cut through, at its two ends by profound excavations, and, curiously enough, that happens here which is also a characteristic of the Kara Koram Himalayas—the gaps are deepest close to the highest summits. Thus, just south of Illimani, a tributary of the Beni river has eaten its way back and back, and finally has cut clean through the Cordillera, so that now the streams that rise on the west slopes of all the southern half of the Cordillera Real, uniting in the La Paz river, actually flow across the Cordillera, through the deep gorge thus eaten back, and empty their waters into the Beni, the Amazon, and the Atlantic. A similar process is going on north of Mount Sorata, where the Maperi river has already got halfway through the range, and is now busily engaged in eating backwards at its head, so that in no long geological period it will cut back to Lake Titicaca, and will ultimately empty that out, likewise, into the Amazon and the Atlantic. All that remains now for it to pierce is the relatively low ridge over which the road to Sorata Town passes, and its crest is less than 2000 feet above the level of the lake, while the distance from Achacache, which is on the margin of the lake, to the pass is perhaps some half-dozen miles. More striking examples of the eating-back action of rivers it would be difficult to find.

In a former paper read by me before this Society, I pointed out how there are indications in Spitsbergen of glaciers eating back at their

heads, just as rivers do; and I suggested that the agency of glaciers was probably that which causes the penetration of ranges of mountains to happen so frequently in the immediate neighbourhood of their highest peaks. Whether the mountain ridge south of Illimani and the other north of Sorata were broken down by the backward eating of glaciers, or whether it is water-action that destroyed them, is of course not easy to assert; but upon Illimani I observed a glacier at the present moment eating its way back through a secondary ridge in a manner that could not possibly be misinterpreted. The ridge that was giving way formed the right-hand support of a considerable glacier. The side of



A BALSA ON LAKE TITICACA.

this ridge remote from this upper glacier forms a cliff, at the foot of which there is a lower glacier, and the lower glacier, by continually carrying away the *débris* split by frost and sunshine from this face, causes the face to retreat into the mountain. The process continually going on has breached the ridge itself at one point down to the level of the glacier supported by it, and now the ice which formerly would have flowed down the upper glacier, is just beginning to break away and tumble over the cliff to the lower one. Allow this process to go forward for a short time, and the whole configuration of the mountain will be changed.

It seems to have been the general impression that, though the  
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western flank of the Cordillera Real consisted of Silurian rock, the peaks of the range were of volcanic formation, and I have often seen Sorata and Illimani referred to as extinct volcanoes. As the result of a careful examination, not only of those peaks, but of the *débris* brought down by the glaciers all along the range, I have been unable to find any trace of volcanic action along the axis of the range. The Cordillera Real has been elevated by a great earth-movement, and the heart of the range consists of granites, schists, and rocks of that description, which Prof. Bonney has kindly undertaken to examine and describe. A transverse section across the range would reveal a central block of such rocks cloven by almost vertical pressure-planes flanked, to the west by Palæozoic, probably Silurian, slates and grits, with which some compact igneous rocks, not belonging to the later volcanic group, seem to be associated. These dip steeply towards the Puna. Further out come beds of red sandstone and conglomerate dipping less steeply. Such, in broad outline, is the comparatively simple general structure of the mountains.

The whole range may be described as rich in mineral products, but of the distribution of these I cannot at present say much. Gold is found at several points, but the chief gold-bearing valleys are those on the east side of the range, and more especially the Tipuani and Coroico valleys. Gold is found in the La Paz river after every rainy season, whilst very rich gold-washings are being worked in a valley whose waters come from the flanks of Mururata. Just below the snowy mass of Cacaaca on the west, there is a really enormous vein of tin, which is being worked by a French company; whilst antimony, cobalt, and, I believe, platinum, have been found in different parts. The great copper deposits are not in this range, but further to the west, especially about the town of Corocoro.

The Cordillera Real between Sorata and Illimani divides itself into two fairly well-marked parts. The point of division is Mount Cacaaca, which stands almost exactly midway between the two terminal peaks, and is third in altitude of the whole group. Between Sorata and Cacaaca there runs an almost continuous series of snowy peaks, some of them sharp in outline; but the range for the most part has been much worn down by denuding action, and the individual mountains have thus been brought to a form very similar to that of the snowy Alps. Almost every one of the mountains reminded me and my Alpine guides of some peak or another familiar to us in Switzerland, so that in conversation we used to talk of one peak as the Rothhorn, of another as the Dent Blanche, etc. The passes in this part of the range seldom sink below the snow-level, though there is certainly one, and there may be two passes, a little north of Cacaaca, which are free of snow in the summer. South of Cacaaca the range is much less continuously lofty. There are three or four big groups of snow-peaks, but between them

are broad stretches where the range does not rise to the level of perpetual snow, and over these lie passes, some of which may be traversed by mules, whereby La Paz is connected with the fertile region of Yungas. Indeed, I understand that there is a proposal to make a railway over one of these passes, and that the physical difficulties to be surmounted, though of course considerable, are by no means prohibitive. I approached several of the passes over the range, but did not actually cross any of them, and therefore cannot describe them. Suffice it to say that it would be quite easy to make good routes for mule traffic across the range at several points, and that such routes, communicating



MOUNT SORATA, FROM THE PUNA.

with the rich country to the east, would materially develop the wealth of the country.

South of the great gap, by which the La Paz river traverses the ancient watershed, the main range is continued, though at a much lower altitude. There is one attractive group of snow-peaks called "The Five Crosses," but they rise very gradually from the high region about them, and it is only their actual summits that are at all steep. They have been ascended more than once, for the most part by persons prospecting for minerals, and certain mineral deposits of a promising nature have been found in their slopes, though not, I believe, towards their summits. We made no attempt to penetrate into this portion of

the range, though I had good views of it from the flanks of Illimani and from the plain to the eastward.

The flora of the high regions of the Cordillera Real appeared to us very sparse, though it is only fair to say that the rainy season must be the time when the flowers are most numerous, and as we quitted the country before the actual commencement of the rains, we probably only encountered the earlier flowers; of their general character I do not propose to speak, for they have been investigated at Kew Gardens, and the results will find their proper place for publication elsewhere. Suffice it now to say that the flowers we found were much scattered about, one here, another there, but that we never came across any carpet of blossoms such as form the great attraction of many high mountain regions. Bird-life was more prolific. Leaving the Puna and the lake out of account, where birds have formed the subject of independent investigation by experienced observers, it may be said that up to an altitude of 17,000 feet, in suitable places, birds were numerous, and in a little tarn close to our base camp on Mount Sorata, at 16,000 feet above the sea, we shot geese, gulls, wild duck, and snipe, besides several small birds; and we saw a number of rather large green-headed humming-birds, of which, unfortunately, I was unable to secure specimens through lack of suitably loaded cartridges. The slopes of broken rocks beside this place were haunted by multitudes of bizcachas, which seemed to thrive exceedingly. Chinchillas we did not see, but from scraps of fur I picked up, it seemed possible that they also might have been found in the same neighbourhood.

Except at La Paz and Sorata Town, the inhabitants of the Puna and the banks of Lake Titicaca were almost entirely Aymara Indians. By them the Puna is densely populated. They cultivate almost every yard of it by their primitive methods during the rainy season, and they obtain tolerable crops of cevada and potatoes. Potatoes, in fact, are one of the chief articles of food that the country produces. There are many varieties cultivated, and they are afterwards prepared for food in a multitude of ways, so that potatoes for food are met with in over a hundred different kinds. Some are put out at night to freeze, and taken in before the morning sun brings on a thaw; some, on the other hand, are dried in the sun and taken in at night to be sheltered from the frost; some are wetted and frozen, and some are dried and frozen, and there are multitudes of other modes for preparing potatoes for the market. The Indians are practically attached to the soil for the most part, and hold their lands by a kind of feudal tenure. Instead of paying a rent, they give their labour to the landlord, cultivating his fields as well as their own, but only according to their traditional systems of agriculture, by which a field is cultivated once in four years and lies fallow for the remainder of the time, whilst at the highest levels of cultivation the turn of a field comes even less frequently.



So long as no attempt is made to interfere with their traditional modes of life, and they are not oppressed by the landlords or their administrators, the Indians are quiet enough ; but they are never well disposed to white men, and the difficulty of keeping them in order is not slight. Bolivia does not possess a large military force or an organized body of country police, for the area to be policed is large, and the white population is very small. Thus the Indians are kept in order more by management than by force, and the great agency of control is not the police, but the priests. The Indians are an exceedingly bigoted folk, retaining under a mask of Christianity their ancient superstitions, little altered. I was seriously interfered with in the prosecution of my



MOUNT CACAACA, FROM NEAR MILLUNI MINE.

researches by Indians, because the nature of my undertaking involved some outrage to their superstitions. Like all semi-civilized mountain folk, they regard the mountains above the level of habitation as a part of the other world, the world of divine and diabolic beings, and the haunt, I believe, of the departed. It was firmly held by the Indians of the Puna, and especially of that part of it which lay round the base of Mount Sorata, that on the summit of one of its peaks there stands a great golden bull and a golden cross, planted by supernatural agency. They considered that the object of my expedition could be nothing else than to obtain possession of these priceless treasures. For this reason partly, and partly through the hostility of the Indians of a neighbouring

village to those of the village whence the porters who accompanied me to the base of the mountains were recruited, my camp at the foot of Mount Sorata was raided one night, and if we had happened to be in at the time, things might have gone hardly with us. As it was, we were then encamped in our small tents among the snow, and the snowy areas are not visited by the natives.

Again, during the progress of my triangulation, it was essential for me to spend some time on the top of a hill that rises out of the Puna in the neighbourhood of a village of particularly bigoted Indians. On this hilltop there stands a *chulpa*, a little building probably enough of pre-Spanish date, which now would be called a chapel, but is really the funeral monument of some departed chieftain. All the lower and more accessible hilltops in this part of Bolivia are surmounted by such *chulpas*, and the natives greatly dislike their profanation by the visits of strangers. At all events, I had no sooner set up my theodolite near the *chulpa*, than the Indians began collecting from all quarters, till I was surrounded by more than two hundred enraged natives. I was alone at the time with one half-breed muleteer, and it was only by the skin of my teeth that I ultimately escaped, abandoning in the hands of the Indians the theodolite, which I fortunately had just time to pack up in its box, and riding away pursued by a stone-throwing and howling mob. I found that they could run almost as fast as my indifferent mule could gallop, and the four miles' chase that ensued before I got within the walls of the town of Achacache was not the least exciting adventure I had in Bolivia. It was necessary to return again to this point to conclude my observations, and, though I went back accompanied by persons having influence with the Indians, I was only just able to complete my work and get down from the hill before the stone-throwing began once more. Attempting to continue the survey on the following day, I found the whole country risen against me; it became necessary to obtain the assistance of a company of soldiers before I could complete my task. These Bolivian soldiers, with whom I spent several days, were an admirable set of fellows, very strong, good tempered, and the best marchers I ever saw. They kept up a kind of trot for hours together across the roughest kind of ground, each man heavily laden, and under burning sunshine. But there seemed no limit to their powers of endurance, and there is little doubt that with good leading they would make formidable troops.

Of the antiquities of Lake Titicaca and the neighbouring plateau I need not here speak, for the important ruins—those on the island of Titi-caca and the neighbouring island of Coati, and the famous megalithic monuments at Tiahuanaco—are well known, whilst the *chulpas* and the ruined villages and ancient burying-places of the prehistoric natives are now being most carefully excavated and investigated for the Washington Museum by Mr. Bandelier and his wife. It is impossible to overpraise

the work of Mr. Bandelier, whom I may best describe as the Flinders Petrie of ancient Peru. Not only does he dig into the ground, but he makes researches equally important into the minds of the living folk; he is thus slowly accumulating a mass of material of the highest interest alike to anthropologists and historians. When I met him, he was engaged in excavating the burial-place and the ruined houses of a village planted high up on the slopes of Illimani. Indeed, there are indications of prehistoric habitation and agriculture on Illimani at a very much higher level than the villages of the present day. One such ruined village was planted at the very edge of a small glacier, and was

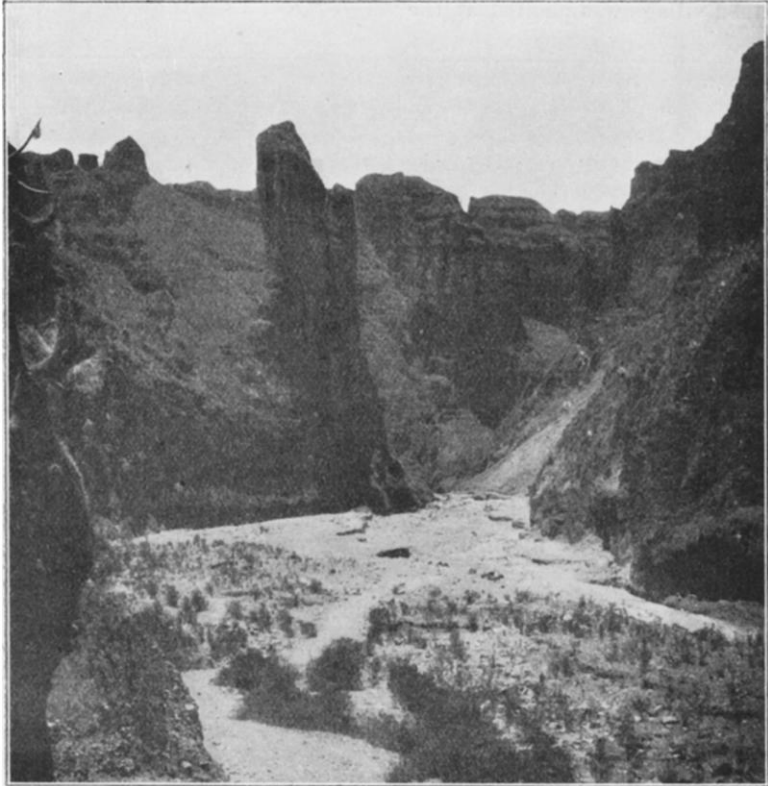


EARTH-PYRAMIDS IN LA PAZ VALLEY.

only reached by a footpath, difficult and even dangerous to traverse. In the burial-places of this ancient peasantry were, of course, found no treasures of silver and gold, but only simple pottery and a bronze pin or two, besides some stones of peculiar shape, which the existing Indians, who helped in the excavation, instantly recognized as fetiches. The second time I met Mr. Bandelier, he had been digging a ruined village of more prosperous character near the town of Sicasica. The mud huts were still standing, in many cases retaining their mud roofs, and each with its little doorway towards the east. Beneath the floor of those huts were buried generations of their bygone inhabitants, just

as Prof. Petrie found in the Egyptian village of Kahun and elsewhere. The skulls of all the adult natives presented the characteristic of a very retreating forehead, artificially produced in childhood, but one interment fortunately yielded the skull of an infant in perfect preservation, whose form, unaltered by artificial means, was proof that the peculiarity of the others was not natural, but artificial.

If the Cordillera Real shows slight traces of volcanic activity, the outer or coast Cordillera shows plenty. Standing high upon the slopes



GORGE NEAR CUSANACO MINE.

of Illimani or of Sorata, we could always see, away to the westward, mountains of unmistakable volcanic type. Indeed, in coming from Mollendo to Lake Titicaca, we passed round the base of the large and famous Misti, which rises to a height of 19,000 feet. On its summit the observatory of Harvard College established at Arequipa has a station, fitted with self-recording meteorological instruments, and every fortnight a man goes up to bring down their records. Further to the south, and along a line parallel with the Cordillera Real, other

volcanoes may be observed at frequent intervals. It was my intention to visit Sajama, and if possible climb it on my way down towards the sea; but the difficulty of getting together a caravan proved too great, and I was reluctantly obliged to relinquish the plan. Sajama is nearly the highest of a group of extinct craters which would well repay careful examination. Further south along the line of the railway that descends from Oruro to Antofagasta, volcanoes are frequently met with. In fact, the whole country is rich in the signs of volcanic activity. Two smoking volcanoes are passed by the train. At one point the line is taken by a cutting actually through a stream of lava, which looks as



ILLIMANI, FROM NEAR CAIBAYA.

though it had been quite recently erupted, so sharp are its outlines, as it lies upon the desert slope. It resembled to my eyes nothing so much as the tongue of a great stone-covered glacier. The whole of this region from Oruro to the sea, with the exception of a few areas artificially irrigated, is an appalling desert, not valueless by any means, for in great hollows of the ground there are white borax deposits that look like lakes frozen over and covered with snow. The mineral wealth of the mountains is undoubtedly considerable. This region has, I believe, been fairly well prospected for minerals, but geographically it stands in need of, and would well repay, a careful examination. In point of scenery it resembles nothing so much as a landscape on the moon,

whilst for weird beauty and strangeness it can find, even in the midst of the Sahara, no superior and few rivals upon the face of the Earth.

After leaving Bolivia, I spent a few days in making the ascent of Aconcagua.\* It was not, of course, a first ascent of that fine mountain, for, as everybody knows, it was ascended by Mr. Vines and my old Himalaya guide Zurbriggen, members of Mr. E. A. Fitz Gerald's expeditions in 1897. Mr. Fitz Gerald was an old friend of mine. I had followed his proceedings with the deepest interest, read all he had written on the subject, and conversed with him about the mountain before leaving home. He had urged me to make the ascent, and had given me all the information possible to facilitate it. My ascent of Aconcagua was not a scientific, but a merely sporting expedition. The mountain had been measured by Fitz Gerald with greater accuracy and care than almost any other high mountain in the world has ever been measured. He had also fixed its position astronomically with great exactitude, and had mapped the peak and its neighbourhood most beautifully. When his book comes out, the public will learn, as they do not yet know, how excellent was the work done by Mr. Fitz Gerald's party. When I returned from my ascent, after only ten days' absence from Valparaiso, the opinion of

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\* Left Valparaiso December 1; crossed the Andes to Baths of Inca, December 2. December 3, rode up Horcones valley and camped at the head of it, about half a mile below Fitz Gerald's 14,000-foot camp. December 4, sent baggage up to site of Fitz Gerald's 16,000-foot camp. December 5, ascended to 16,000-foot camp. December 6, ascended to about 18,500 feet, and camped near the south edge of the great north-western slope of screes. We thought this was Fitz Gerald's top camping-place, because we found an old duster there, but it must have been brought by wind. December 7, started at 3.30 a.m. up the screes, following thence forward a line of ascent different from Fitz Gerald's. At 7 a.m. Pellissier turned back ill. Between 9 and 10 a.m. reached foot of second or third gully (counting from north-east to south-west) in the highest rock-wall. Climbed this gully to the summit ridge, which was struck between the highest peak and the lowest point in the summit ridge. Turned to the left (north-east) along the narrow snow *arête* towards the highest point, and climbed over several undulations to the top of a peak near, and not many feet lower than, the highest peak. It was then about noon.

There was absolutely no difficulty between this point and the highest peak, though the ridge thus far had not been easy. All difficulties being thus overcome, and the ascent not being a first ascent, I decided to descend, for two reasons: (a) because it was advisable to get back to Pellissier as quickly as possible: (b) because Vines, when he ascended Aconcagua, made a record for altitude, and I thought it likely that, if I reached his peak, I should be accused of mere jealousy, whereas if, after overcoming all the difficulties of the mountain and being within ten minutes of, and at the very outside 50 feet below the highest point, I turned back, I could not be so accused.

At noon exactly we turned back and went down the way we had come. Reached top camp in two and a half hours. Found Pellissier badly frost-bitten, and realized that it was essential to get him down to mule-level at once. Descended with all baggage in forty minutes to middle camp; packed that up, and descended in forty minutes to foot of slope, fifteen minutes to Fitz Gerald's 14,000-foot camp, fifteen minutes to our base camp, which was reached at 6 p.m. December 8, descended with all baggage to Inca. December 9, sent off baggage for Valparaiso. December 10, started at 5 a.m., crossed the Cordillera, and reached Valparaiso at 11 p.m.

uninformed persons was that I had in some fashion surpassed the exploits of my predecessors, who spent seven months or more on or about the mountain. To begin with, had they not preceded me, I should probably have wasted the best part of a month in searching for the way, which is by no means obvious. Again, the time actually spent by them on the ascent was little longer than that taken by me. Each of their camps was a well-fitted observatory; at each they made long series of observations. The mere determination of the position of the Inca Hotel, from which they started, as I did, took them a month or more. They



ILLIMANI AND THE PICO DEL INDIO.

made a complete examination of the geology and natural history of the neighbourhood. Thus my climb cannot be compared with their expedition in any way, and I am the last to desire any comparison between the two to be made. If, hereafter, the summit of Mount Sorata is attained by some more lucky climber than I was, he will owe to me the same recognition that I gladly render to Fitz Gerald.

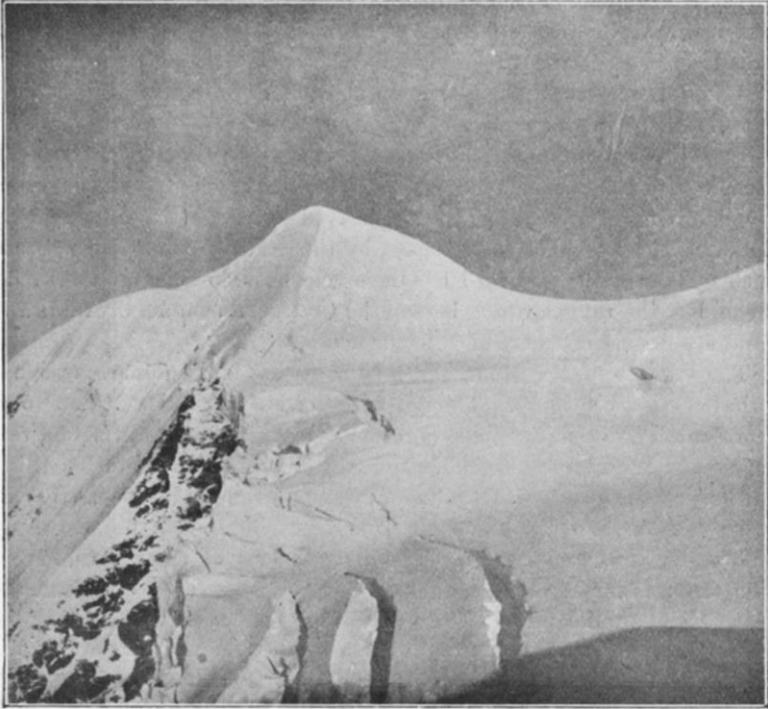
After returning from the ascent of Aconcagua, I took ship at the southern extremity of the Chilean railroads to Lota, the famous copper and coal mine centre. Passing southward along the west coast in the steamer, we entered Smyth's sound at the Gulf of Peñas. A few days

were spent in the sound, where I was, fortunately, enabled to land at several points and make short expeditions into the neighbouring mountains, and then by the Straits of Magellan I came to Sandy Point, where I halted for a few weeks. During that time, by the kindness of the Chilian Government, a steamboat was placed at my disposal, and I was enabled to attempt the ascent of Mount Sarmiento, the highest and finest mountain in the Fuegian district. I also made an expedition over the Patagonian Pampa to some of the secluded inland waters that long ago attracted me when I first studied them on the Admiralty chart. To this part of my expedition I can only now briefly refer. The character of the scenery of Smyth's sound closely resembles that of the inland passage along the coast of Norway. In both cases, the mountains are formed of hard rocks, granites, schists, and the like; in both these rocks have been polished for long periods by an ice-sheet, which has rounded the valleys and the summits and apparently enveloped the whole range; in both cases the mountains have passed through periods of elevation above the sea, and then of depression into it; in both cases they have been depressed in the more recent period, so that the valley-bottoms are sometimes as much as 1000 feet below the level of the sea; and in both cases this period of depression seems now to be passing away, and the land is being raised once more above the waters. Smyth's sound enjoys a higher reputation for beauty of scenery, but this reputation is, I think, greater than it deserves. Certainly, in point of beauty, the Norwegian inland passage is its superior. Smyth's sound lacks variety of scenery. At one or two points, indeed, there are specially fine views—as, for instance, below the fine promontory named Bold head, or where Trinidad channel opens to the west, disclosing a multitude of beautiful islands, or beneath the snow-clad Cordillera Sarmiento (not to be confused with Mount Sarmiento of Tierra del Fuego), or where the majestic mass of Mount Burney rises by the channel. But in a general way there is a dead level of scenery, fine indeed, but not of surpassing grandeur.

The characteristic of the views is the dense forest which covers the lower slopes of all the hills and islands—a primæval forest of stunted trees, rising out of the ruins of their predecessors, which are rotting and tangled together on the ground, thickly overgrown by moss, offering to the traveller every possible impediment. Higher up, in situations naturally well drained, the forest is more open, and there are occasional bogs occupying the sites of former ponds or lakes, and barren areas of polished rock too steep for earth to collect upon; whilst the tops of the hills are sometimes faced by precipices, and are themselves often relatively bare of vegetation when they do not reach to the level of perpetual snow. Looking inland up the numerous channels which open out from the sound in succession, one often beholds snowy areas, great gathering-grounds of snow, drained by glacier tongues which sometimes terminate in the water. If it were not for the bad weather that infests



this flank of the submerged mountain area, these regions would offer a fascinating subject for a mountain explorer. As it is, I fear they are not likely to attract minute investigation until the more agreeable mountains of the world have been better explored than they are now. The western arm of the Strait of Magellan offers far more splendid scenery to the contemplation of the voyager than does any except the southernmost part of Smyth's sound, but this has been so frequently described that I need not pause upon it now.



TOP OF ILLIMANI, FROM THE PICO DEL INDIO.

I was surprised to find how splendid are the mountains of Tierra del Fuego, which culminate in Mount Sarmiento. It is not that they are actually high, reckoned from sea-level, for Sarmiento is only a little over 7000 feet, but they are so unusually fine in form, and are draped by such magnificent glaciers. The actual height of a mountain, as measured from the sea, is not a true test of its size. Mount Sorata, for example, really begins at 13,000 feet; all that is below, it possesses in common with the great tableland on which it stands, and it is not till about 16,000 feet that the actual peak begins. Illimani, on the other hand, stretches its slopes down to the very depths of the valley

of La Paz on the one side, and to the lowlands of Yungas on the other, so that it is seen from base to summit—a mighty mass, whose top is at least 17,000 feet above its foot. Mount Blanc is practically a mountain no more than 10,000 feet high, though its summit is nearly 16,000 feet above sea-level; while if the Alps were sunk into the sea till all that part of them were submerged which may be traversed without real climbing, there is hardly a peak that would rise 5000 feet above the surface of the waters. Mount Hedgehog, in Spitsbergen, is only about 5000 feet in height, but every one of those 5000 feet has to be climbed, and, as a problem for the climber, Mount Hedgehog is more difficult than most Alpine peaks. The 7000 feet of Mount Sarmiento are all difficult of ascent, and the climb may be said to begin near the very level of the sea, so that the snowy mass of Sarmiento is larger than that of Mount Blanc, and almost as large as that of Mount Sorata. Here again we were under the impression that we should find traces of volcanic action, but we found none. Mount Sarmiento, and the range of which it forms a part, has been upheaved by a great earth-movement, and carved out from a vaster mass by the action of denuding forces. Much further to the eastward I believe volcanoes do exist on Tierra del Fuego, but the ranges which border the Cockburn channel or Admiralty sound are devoid of traces of volcanic action.

The climate of the Mount Sarmiento region is by no means so bad as that of Smyth's sound. Though we were unfortunately driven down before actually reaching the summit of the peak, by a storm of great violence, which it was impossible to maintain ourselves against, I think that here is an area in which mountain exploration might be carried on with some prospect of reasonable enjoyment, and with the certainty of obtaining valuable results. The arrangement of the ridges, except those that border Beagle channel, is not yet by any means clear. A great part of the island of Tierra del Fuego which is marked blank on the map, is occupied by mountains, whilst the glacier development is considerable. An examination of these glaciers led me to conclude that, in character, they must be placed between the truly arctic glaciers, such as we saw in Spitsbergen, and those of temperate regions. They have much of the apparently greater viscosity of arctic glaciers, pouring down their slopes and bulging at their snouts very differently from the glaciers of the Alps. The most remarkable glacial feature that we saw was a rocky basin of great extent, just at the foot of the north slope of Mount Sarmiento, filled by the great supply of *névé* that comes down that slope, and overflowing in three different directions, to east and west and north, where three separate tongues of ice find their way almost into the sea. One of them, by which we mounted, is only separated from the sea by a narrow belt of forest-clad moraine, and it is evident that, not so long ago, the snout of the glacier must actually have reached the water. But, as I explained in connection with the glaciers of

Spitsbergen, a glacier ending in shallow sea must sooner or later build in front of its snout a wall of moraine, which must ultimately cut it off from the water. Such moraine walls, dividing glacial snouts from the sea, were found by us in several places in the neighbourhood of the Sarmiento range. Our examination of this district was of course very cursory, but to me it is intensely interesting, and I hope that, before many years, some better-equipped mountaineer will find himself in those parts, and will devote a whole season to the exploration of the glaciers. Sandy Point is now developing into a town of considerable importance, where all necessary commodities can be obtained, and where, at the right season, a traveller would be able to hire boats and engage companions.

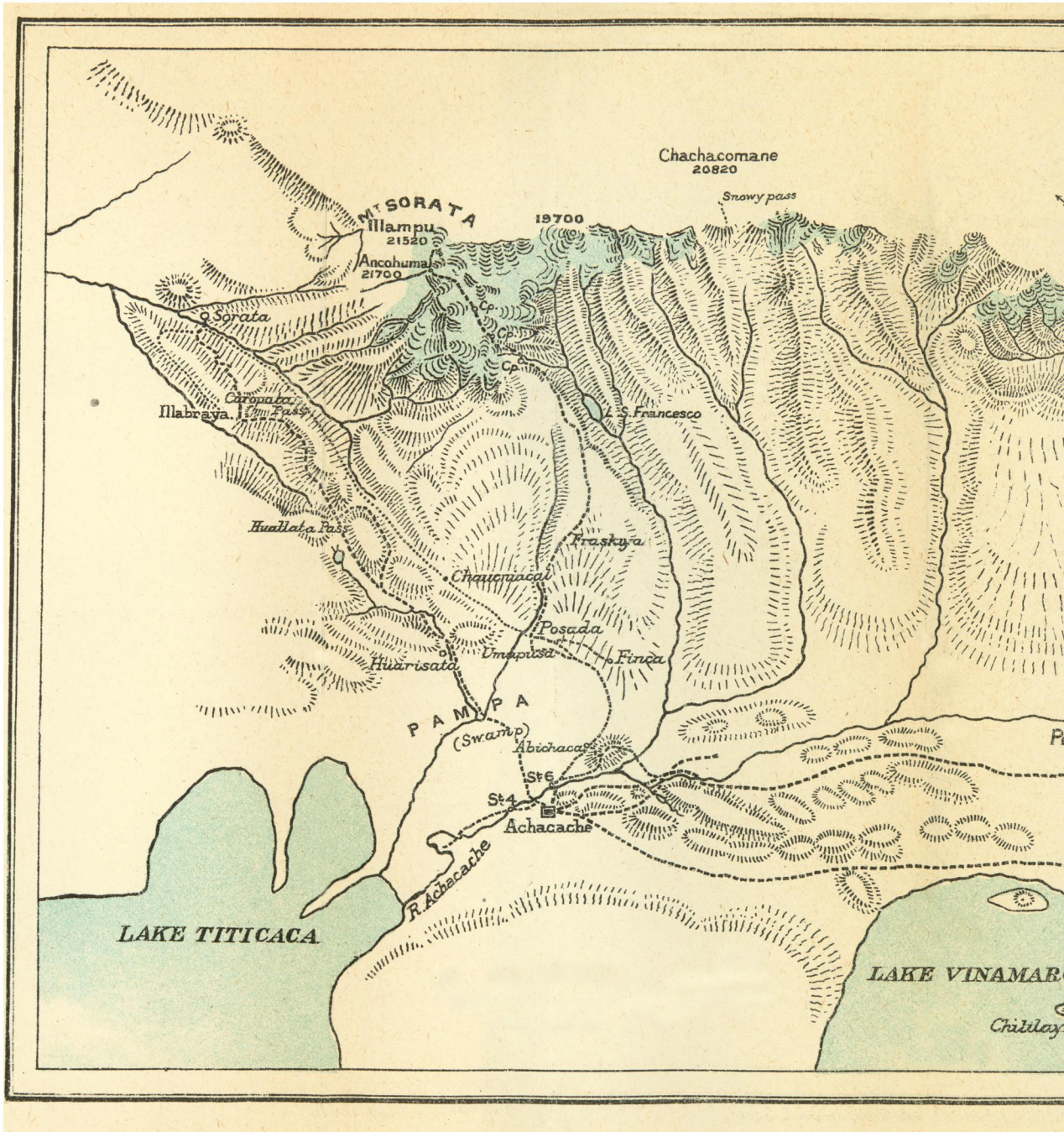
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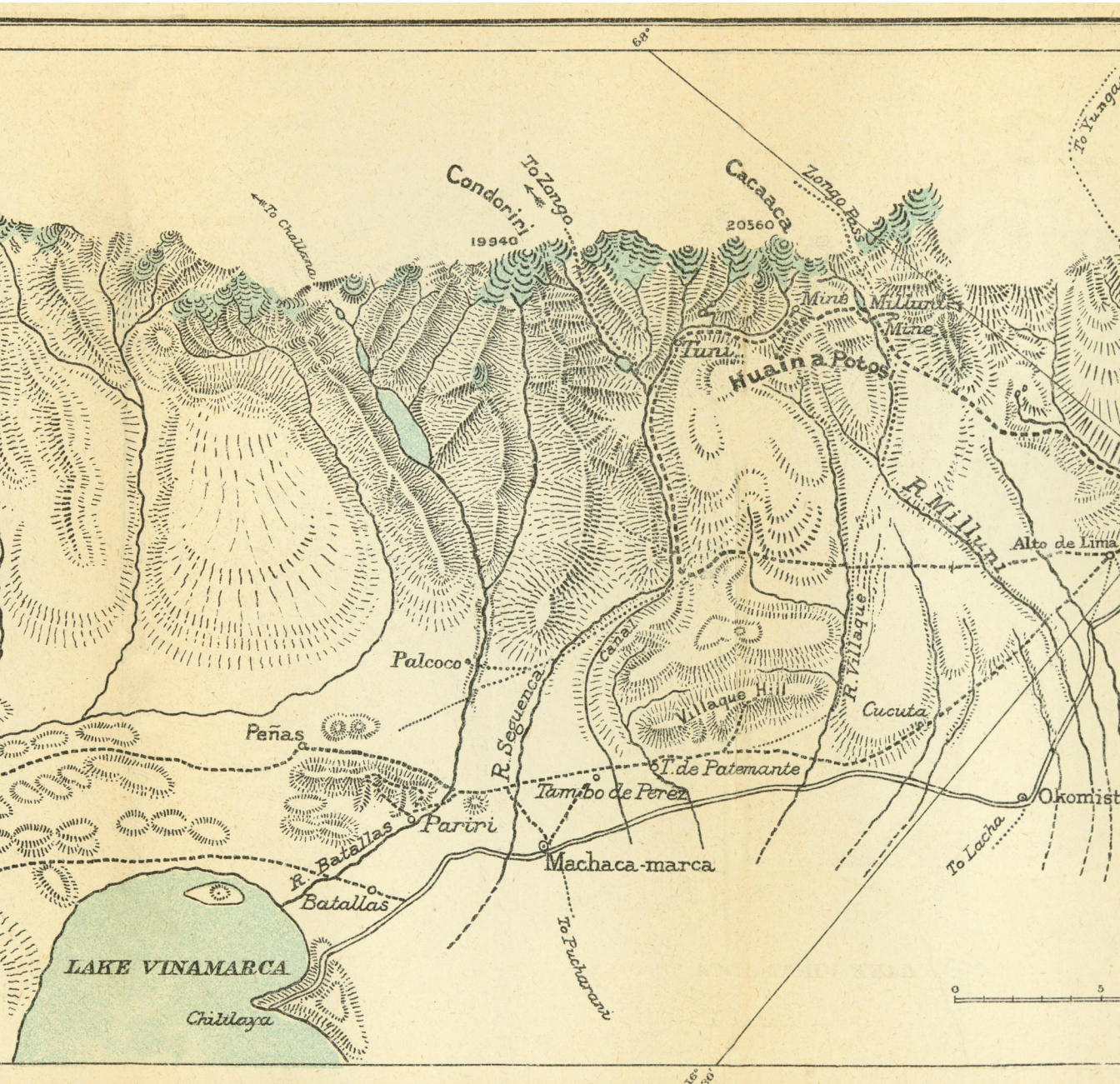
Before the reading of the paper, the PRESIDENT said: This evening we have the pleasure of welcoming here again Sir Martin Conway, who has given us so much interesting information in regard to such distant parts of the world as the Himalayas and Spitsbergen. Now we are to hear from him some of the results of his very interesting journey to South America.

After the reading of the paper, the following discussion took place:—

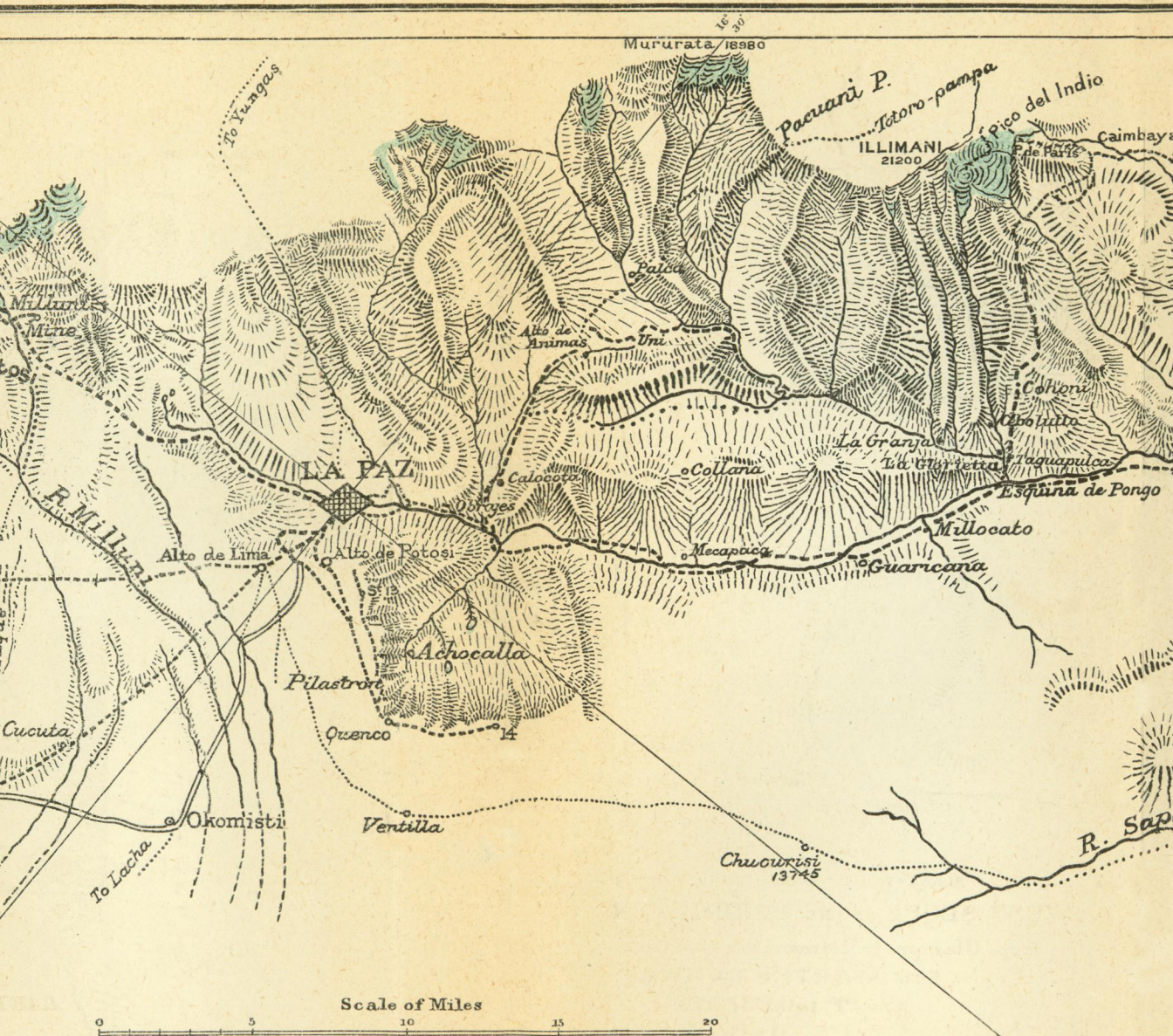
Señor ARAMAYO, the Bolivian Minister: A few nights ago, under this same roof, I had the pleasure of congratulating Sir Martin Conway on the wonderful success of his ascents of the highest peaks of the Andes, and of thanking him, as I do now again, for the most complimentary manner in which he has referred to my country and to myself. I am sure that his lectures will have a great part in bringing Bolivia into closer connection with the scientific and commercial world, and he may be assured of the esteem and gratitude of my fellow-citizens. I thank you, Mr. President, for giving me the opportunity of acknowledging our indebtedness to Sir Martin Conway, and I take this opportunity of congratulating the Society on this addition to their succession of triumphs in the cause of science.

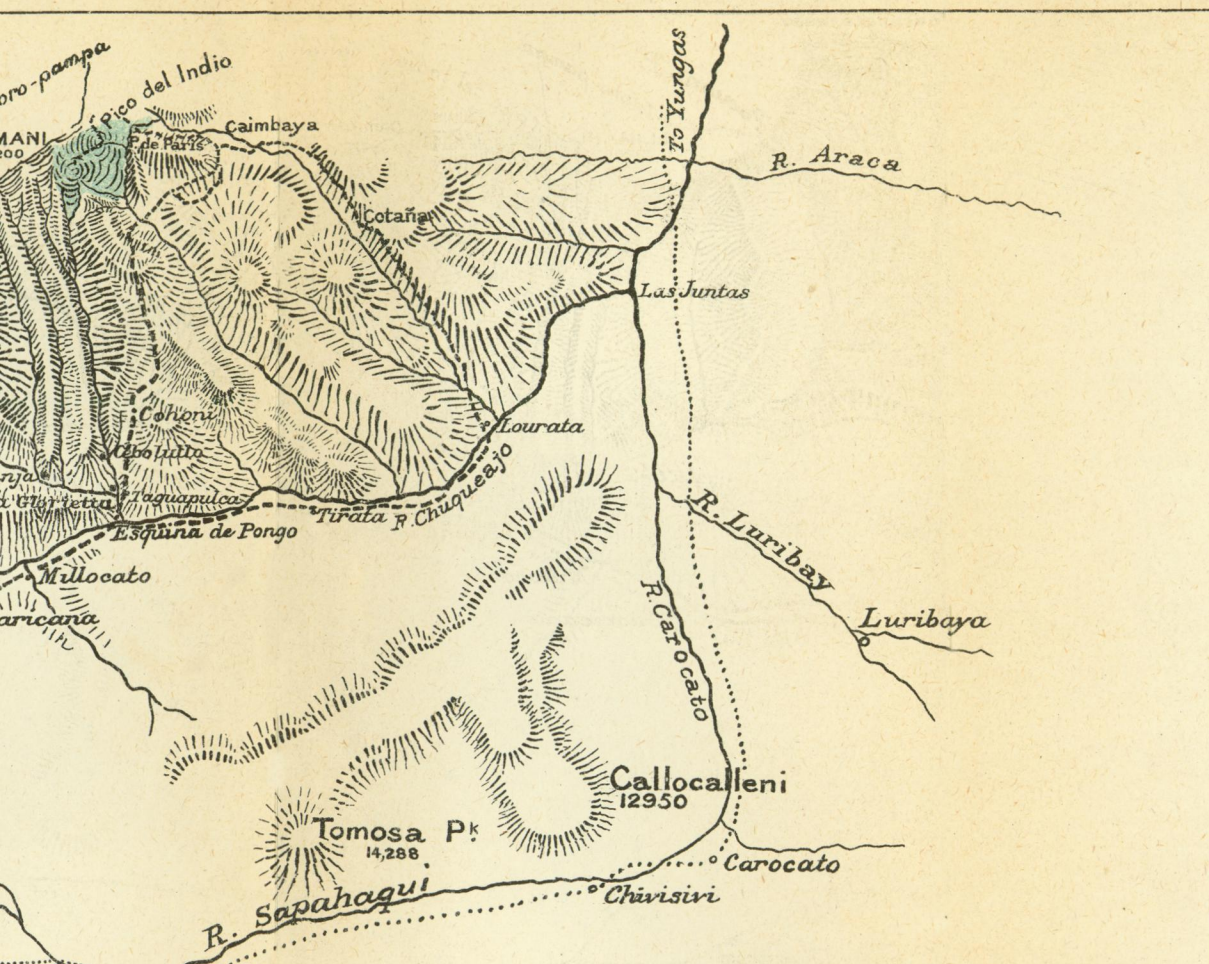
Prof. BONNEY: I am sorry to say that since I received Sir Martin Conway's rocks I have only been able to afford the time to give them a cursory examination, but I have seen enough to perceive that he has settled one question which, up to the present time, was a matter of doubt. Various statements have been made as to what was really the nature of the Cordillera. David Forbes, in his excellent paper to the Geological Society, stated that the summit of Illimani consisted of Silurian rock. d'Orbigny said it was granitic. Now, ascending from the eastern slopes you pass a series of slates and schists, probably of Devonian and Silurian age. Above that, from the highest parts of the mountains, Sir Martin Conway has brought a series very difficult to decide upon without microscopic examination. Some are of igneous origin, but quite different from those generally found in the Andes. The Pico de Paris is a fine banded gneiss, and the Pico del Indico is of coarse granite. In the same way, Sorata consists of a series of crystalline rocks, such as you might get from the central part of the Alps. It is remarkable that the volcanic rock of the Andes is almost wholly confined to the western series of mountains. Only from one place on the lower slope of Illimani has Sir Martin brought one of the typical Andes rocks, such as have come from Aconcagua, and as Mr. Whympfer has brought from the Ecuadorian Andes. The physical structure is remarkable. The crystalline rocks form the most eastern of the ranges, and it is worth noticing that the only rocks of that type were brought by Mr. Whympfer from the most eastern peak of the Andes he visited in the Ecuadorian region. The origin of those gaps in





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PLANE-TABLE SKETCH-SURVEY OF THE  
**WEST SLOPE OF THE CORDELLERA REAL**

from Illampu to Illimani, surveyed and drawn by

**SIR MARTIN CONWAY**

Sep<sup>r</sup> 1<sup>st</sup> to Oct<sup>r</sup> 31<sup>st</sup> 1898

LaPaz 10<sup>th</sup> November 1898.

Route -----

Heights in feet.

68°