being generally attributed to his long and severe service in the Himalaya.

It is to the arduous, conscientious and unadvertised labours of these surveyors that both mountain climbers and explorers of these regions owe, and must continue to owe, a great debt of gratitude. The delineation in the Indian Atlas of topographical details in the regions of ice and snow is admittedly imperfect. The accuracy of maps is merely a question of degree, for no ordinary scale map can possibly be free from error; but it should be remembered that there is no other mountain region of the world at all comparable in extent to the northern frontiers of India, the physical features of which have been laid down with any approach to such a degree of accuracy.

Three Weeks' Camping-out in the Andes.

By WALTER LARDEN.

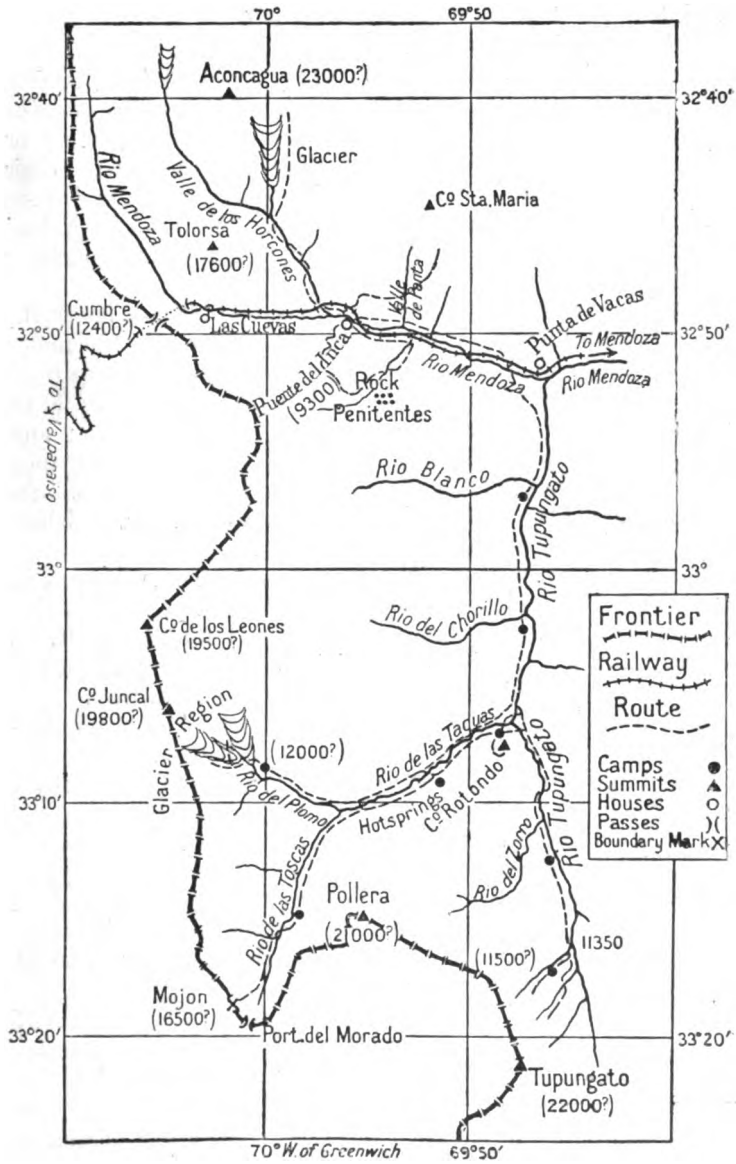
[*** The substance of this narrative and the illustrations are, by the kind permission of the Publishers, taken from a forthcoming book entitled 'Argentine Plains and Andine Glaciers.' (T. Fisher Unwin.)]

I.

IN August 1908 I went out to Argentina to pay a long visit to my brother at his estancia in the province of Santa Fé.

Some time before—I forget how long—I had read of climbs in the Andes made by Dr. Helbling, Dr. Reichert, and others who were living out there; and my old friend the guide Abraham Müller of Kandersteg had suggested to me the possibility of my being able to join Dr. Helbling for a time, and so of my seeing something of some part of this comparatively little-known range. And, to further this plan, both he and the doctor at Kandersteg had written to Dr. Helbling about me.

I did not feel my prospects certain enough to justify me in launching out into any special and expensive outfit; but, on the off-chance, I took with me to Argentina my ordinary Swiss



MAP OF PART OF THE ANDES SHOWING MR. LARDEN'S ROUTES.

climbing-gear, and also a jäger sleeping-bag, with a large macintosh sheet to go under and over it.*

In Buenos Aires I saw Dr. Reichert, and learned something of the style in which he and Dr. Helbling 'took' the Andes, and of the outfit needed. It was their custom to go into the mountains with mules and mule-men only, no porters or guides going with them, so that they had to rely on their own strength for all the mountain-work. [The mule-men (*arrieros*) were quite useless away from their mules; indeed their flimsy boots did not allow of any rough walking on their part.]

The highest camps had to be made at some 11,000 or 12,000 ft., since at higher levels even the coarsest pasture for the mules failed. From these camps the climbers would carry up their sleeping-bags and other gear (a load, I believe, of from 30 to 40 lbs. per man) to a height of perhaps 18,000 ft. or so; and there would sleep out in the intense cold. And next day they would make their shot. In this way (to mention two climbs only) Dr. Helbling had climbed Aconcagua and Dr. Reichert had found his way up Pollera (21,000 ft. ?).

To cut a long story short, after a stay of some months in the plains (a stay which the heat and the terrible locust invasion combined to make somewhat enervating) I found myself, on February 2, 1909, setting out to join Dr. Helbling at Puente del Inca, a station high up on the Transandine Railway.

My companion-to-be had been used to the 'each-man-for-himself' principle; if one man had to turn back on account of mountain-sickness, the other went on; if one man wished to stay behind for a second shot at a mountain, the mules and men were divided. A like independence was the condition of my joining; and certainly, considering the twenty years difference in our ages, and Dr. Helbling's exceptional strength (as evidenced by his feat on the Matterhorn and by his ascent of Aconcagua), it was abundantly clear that his powers ought in no way to be limited by mine.

I joined the main line at Junin, and set off for Mendoza (I could not book further) at 2 P.M. Journeys in the Pampas are much like journeys at sea. You are 'in the plains' for so

* I had better say at once that this sleeping-gear was absolutely inadequate, even for use in a tent and at a height of but 12,000 ft. I used it inside a very much thicker and warmer waterproof sleeping-bag, provided with air-cushions underneath, that Dr. Helbling kindly lent me; and, even so, I felt the cold much.

many hours, as you are at sea. Always the same treeless levels covered (in these later days) with vast sheets of alfalfa, or with the crops of the industrious Italian colonists; always the same sharply-cut circle of the near horizon moving with one.

We reached Mendoza at 5 A.M. next day, the promised half-hour of the time-tables having been lost; and it was only by the help of some friendly Chilian fellow-travellers, and a liberal tip to a sort of official, that I got on at all; even so I had no ticket for my luggage. We now changed to the narrow-gauge cogged mountain railway, and began to climb. Before us were the huge bare masses of the Andine range. Desolation was the keynote of the scenery. From Mendoza upward I never saw a tree (save a few planted by the station of Uspallata); there were no chalets, no cows or sheep, not even goats, no turf, no waterfalls. Huge, incredibly huge, masses of débris, scree-slopes bare of lichen that seemed on the verge of motion, thorny scrub, scant tufts of hay-like, sand-drowned grass; and below us, as we wound our way up a gaunt gorge, a red muddy torrent (the river Mendoza) that at the time I failed to recognise as a glacier-stream.

At first we did see some snow-peaks, Tupungato being the only one of which my climbing acquaintances could, later, give me the name; but they hardly suggested any great glacier regions worthy of such a range. Soon we lost sight of these, and barren mountains, in the very process of dissolution, hemmed us in.

We reached Puente del Inca about noon; but, owing to the forgetfulness of an Englishman whom Dr. Helbling had commissioned to meet me and to send me on into the mountains where he was already, I had a day and a half at the hotel in which to look about me.

For the stretch from Punta de Vacas to Las Cuevas the railway runs up a barren valley of no great inclination. At Puente del Inca ('the bridge of the Inca') the river has burrowed out a short tunnel or bridge; and from the sides of the gorge there well out springs of hot water, highly charged with carbon dioxide, dissolved calcium carbonate, and various soluble salts, that are made use of for baths. (Curiously enough, I have seen the bridge and the baths depicted in a well-known magazine, and described as railway works at Puente del Inca!)

A stay of a day and a half at the beginning, and eight days at the end, of my visit to the Andes perhaps hardly justifies

me in giving my opinion on this health-resort. Still, I think that some of the characteristics must be fairly permanent.

The valley is very desolate; scattered weeds and the thorny and inflammable acerillo bush form the main vegetation of the valley-bottom; and the hill-sides are singularly bare. A weird little plantation of this somewhat forbidding-looking acerillo had been laid out by the hotel people to represent (or caricature ?) a garden.

Sitting before the hotel after breakfast, there was something in the freshness of the air and in the wide prospect down the valley that was stimulating and refreshing. But about noon began the never-failing Andine wind (so much spoken of by travellers that I do not think I can have been peculiarly unlucky in my experience); and after that no peace! One went out walking sideways, holding one's hat on; and the sand, sand, sand drove pitilessly. How I longed for the green turf, the pine-woods, the clear streams, and the windless calm of such a place as Arolla! Speaking of streams, I may say that during my three weeks up in the mountains I saw but one stream, and that a small one, coming down the hill-sides; for the water-falls of Switzerland one looked in vain. Only here and there one saw a white stain where some lime-and-salt-laden spring issued forth; just round and below this would be a patch of dark-green rush-like grass; but the water soon sank in the thirsty soil again, and a short way lower down the slope, as a rule, all would be bare and dry.

On the evening of February 5 two arrieros arrived, sent back by Dr. Helbling to fetch me and some fresh provisions; and about 7.30 A.M. next day we set off down the valley. We rode for some 3 hrs. or more; and then, before we reached Punta de Vacas, turned down to the river to ford it so as to cut off a corner into the Tupungato valley. This first crossing was a very mild affair; but I noticed that the two arrieros looked back and watched my face to see how the new member of the party took his first fording. Later on in our expedition Dr. Helbling and I had some that were dangerous enough. When a glacier stream, in the bed of which you hear the boulders rolling and knocking together, is so deep that the water on the up-side will come in at the top of a high riding-boot if the leg be not raised, it can be imagined what the pressure on the mule must be; and one wonders how the animal can keep its feet on such a torrent bed.

We next forded the Rio Blanco and waited for Dr. Helbling; he and the head arriero, Ambrosio, turned up in the afternoon.

Camp at Mouth of Rio del Chorillo

Crossing a Dry Gulley on Mules

They had been exploring up this valley; and the torrent, which we found nasty enough, had so increased with the several hours more of heat that the baggage mules had to be left behind. So this first night we spent without tent, and with only my jäger bag and macintosh between us. However, we were not as yet as high as Puente del Inca, and with the help of a fire we did very well. Next day we set off up the left bank of the Tupungato. The only possible route was close to the river, which could not yet be forded. In two places there had to be navvy-work done on the chaotic collection of boulders before the mules could pass; so we only got as far as the mouth of the Rio del Chorillo that day. Here we camped among sand-dunes, the cores of which were, I believe, acerillo clumps which the drifting sand had overwhelmed. There was abundance of acerillo to burn, some hay-like grass for the mules to eat, and the red muddy water of the Rio Tupungato to drink; so the essentials for a camp were there.

I may say that all the streams that I saw, with the exception of three, were so thick with red mud that I have mistaken boiling water for cocoa. The Rio del Plomo issued from the glacier in the same condition; and of green-white 'gletscher-wasser' I saw none. Next day, as soon as we had breakfasted and loaded the mules up, we set off; and before long forded the Tupungato River where it was much broken up.

Hitherto I had admired the way in which the mules had negotiated the tumbled boulders; but now I was to witness their extraordinary sure-footedness on steep inclines, when we, forced to leave the river-edge, traversed the hill-side higher up. The masses of débris on the sides of the valleys were of incredible magnitude; and for the most part, if we disregard the surface sheets of loose scree that we encountered here and there, were more or less consolidated. Indeed, one came across quite hard conglomerate rock that appeared to have been formed out of débris. Arid though everything was at the time, the wide shingle-covered beds into which the valleys opened here and there, as well as the numerous dry gulleys, gave evidence that there were seasons of heavy rain or of melting snow. And the side-torrents of such seasons had carved out the hard débris into veritable cañons. Two such we passed, though not quite without accident. Another was quite impracticable; but, luckily, we were able to make our way down to the main stream, and there found just footing enough along the edge to enable us to pass the mouth of this steep-sided gorge.

To illustrate the difficulties that we here encountered, I may

mention the fact that on one occasion my mule took the last bit up (the illustration gives an idea of its character) with a scramble, collided with another mule, and slipped back. I somehow sprang off on the upper side and held on to the bridle. Since the animal still had some hold for its front legs, I managed to get it up. In two other places a baggage-mule slipped and fell; and in one of these cases the creature might well have been killed. Their loads were perhaps 100 kilos.

We camped that evening some distance above the mouth of a valley, unnamed in the Chilian map, which our arrieros called the *Cajon del Zorro*.

Next day was a short one. We soon reached the point marked 11,350 ft. in the sketch-map, and (here was our mistake) turned up the valley to the right. We camped where we found the remains of a rough fire place built of stones, and a ring of stones indicated the former site of a sleeping tent. Dr. Helbling, I think, told me that two parties had been there before us; viz. that of Mr. Vines, and that of Dr. Reichert.

Dr. Helbling's plan was to stay here for a week if necessary, in order to attempt Tupungato (22,200 ft. ?). Up this big mountain a N.W.ly shoulder or arête afforded an easy route. There is no climbing; the difficulty lies in carrying the necessary sleeping and other gear up to a sufficient height, in enduring the cold of the night tentless, and in climbing the remaining 4000 ft. or so next day in spite of mountain-sickness and the intensely cold wind. For my part I had a wakeful night of silent debate. Here, at but 11,500 ft. or so above the sea, though encased in my jäger bag, and this again inside the heavy Swiss bag lent me, and inside a tent into the bargain, I found I could hardly keep sensation in my feet. (I may say that it froze hard at night even at our camp.) It was forced upon me that, even could I carry the necessary load up to 18,000 ft. or so, I certainly could not stand the exposure of sleeping out. I was, in fact, no match for my companion, with his exceptional powers and his twenty years advantage in age. So I reluctantly made up my mind that I must make day expeditions only, while Dr. Helbling made his shots at the mountain. Our compact allowed for this independence. I accompanied him on his first search for a sleeping-place; and will only say that a scree-slope that took us 5¼ hrs. to ascend (and we used solid ground where we could) took me but twenty minutes to descend when I committed myself to the loose stones. This gives some idea of the mobility of the scree; one glissaded or skated down.

PENITENTES ON AN ICE PATCH

PENITENTES—THEIR ICE BASE CONCEALED BY RUBBLE

The second time that I went with him (for the first place chosen proved to be out of reach of the mountain) I came across the celebrated *nieves penitentes*.

I must call attention to the fact that I was in the Andes only in one region, and only for three weeks in one particular month; and that even the far greater experience of Drs. Helbling and Schiller, on which I was able to draw, was, broadly speaking, limited in somewhat the same way.

With this caution to my readers, I will give first my observations, and then say something of the theories relating to the origin of these strange formations.

(1) All snow-patches that I saw had been converted into ice by the action of sun and frost; and every such ice-patch was broken into blades, prisms, columns, or pyramids of ice. You did not walk *on* a snow-patch, you threaded your way among penitentes.*

(2) The mobile scree would often invade these patches; so that the ice-base on which the penitentes stood got covered. One then saw apparently detached ice columns standing out of the rubble. But, digging with the ice-axe, one could find the connecting ice-base. This is worth mentioning; for I believe one theorist has suggested that the ice was split up through the sliding movement of the rubble-base on which it lay. This view I believe to be quite wrong; the detachment of the columns is apparent only.

(3) Where there was a blade-formation, Drs. Helbling and Schiller both considered that this was due to the fact that the sun fell on the ice only during a part of the day; and that the blades then formed stood edgeways to the mean direction of the sun's rays. My own experience of one such patch made this view seem to me probably the right one.

(4) I did not see any clean glacier or part of one, of whatever angle of slope, that was not broken into penitentes. But these appeared to me to be bigger (though not necessarily taller) and clumsier in form than the penitentes of the ice-patches. In this connection I must, however, mention the fact that the parts of the glacier which I observed were at a much lower level than the ice-patches; and that there was melting going on on the former, but not on the latter. I should surmise that this melting had much to do with the clumsier form of the glacier penitentes. I saw no place on a clean glacier *on* which you

* When, hereafter, I speak of 'ice-patches' I shall mean ice-patches that had originally been snow.

could walk; you had to make your way in and out among penitentes.

(5) I saw no penitentes on moraine-covered ice. While the clean ice-patches or the clean parts of glaciers were startlingly unlike what one comes across in Switzerland, the moraine-covered sides of the glaciers had nothing unfamiliar in their appearance.

(6) As far as my experience goes (but I had no binoculars with me) I cannot say that I saw any clean snow or ice high up on the mountain that was not broken into penitentes. At least I can state that penitentes are not a phenomenon of the relatively lower levels only.

(I may mention the fact that our arrieros used the word for the more permanent masses of snow or ice. '*No hay penitentes por alli*' meant 'There are no snow-fields or glaciers there.')

(7) Though among the larger penitentes (which I should say ran up to 14 ft. or so in height) were smaller formations with which I had become familiar in Switzerland, nevertheless the penitentes of the Andes strike one with amazement. I am convinced that no one should attempt to explain them until he has seen them.

Now a word as to theories; and I will give some negative opinions before making any positive suggestions.

(*a*) My own experience, as well as the far wider experience of Drs. Helbling and Schiller, is absolutely against any connection between inequalities in the density of the snow or ice due to avalanche motion or sliding motion, and the formation of penitentes. These were just as remarkable on ice-patches lying on a flat valley-bottom as on those resting on a hill-side.

(*b*) I believe that it has been suggested that penitentes may be only exaggerated cases of the ice columns that one notices under glacier tables. I will only repeat that I saw no penitentes on ice that was much covered with rubble; they were most remarkable on the cleanest ice.

(*c*) I think that I am right in understanding that much capital has been made out of the fact that there is a 'west-and-east' arrangement in penitentes, and that the prevailing wind is westerly; the conclusion being drawn that the wind is the main cause of this peculiar formation. With respect to this I would point out firstly that it is physically impossible that a west wind should give a westerly current of air on the sides and bottom of deep valleys running in any direction whatever;

and secondly that penitentes are formed in sheltered nooks quite as much as in more exposed situations.

The only 'west-and-east' condition that obtains everywhere is not that of a westerly wind, but of the apparent diurnal motion of the sun.

Now to come to some positive suggestions. Only I would first say that what we need is observation of the year's life-history of our penitentes; an observation which possibly could be effected from Puente del Inca as a base.

It seemed to me that the conditions which obtain in the Andes differ from those obtaining in Switzerland in four respects:

Firstly, the sun is more vertical and more powerful, and the period of fine weather far longer.

Secondly, the air is far drier. Our cracked finger-tips were one evidence of this.

Thirdly, there is more wind.

Fourthly, the temperature of the air itself is very low.

All four conditions together point to evaporation (not liquefaction) of the ice where exposed to the sun; and a freezing temperature in the shade.

I cannot attempt to explain why these conditions should result in the formation of penitentes; but certainly they would enable the sun to work its will in carving out the snow or ice without much accompanying degradation due to the action of water trickling down.

I was much struck by the dry look of the bristling ice-patches even when these lay on stony valley bottoms.

The 'west-and-east' arrangement of penitentes, on which much stress has been laid (though I cannot say that I noticed it myself), would again, as already indicated above, point to the sun as the main agent in their formation.

(*To be continued.*)

THE WINTER EXHIBITION OF ALPINE PAINTINGS.

The Picture Exhibition of December 1910 was one of the normal kind, to which members were invited in general terms to send pictures by themselves or their friends.

On the whole we are inclined to believe that this type of exhibition, whether or no it be the most effective for the purpose of promoting Alpine art, is the one which gives the greatest gratification to the largest number of people.

The admirably got-up catalogue contains one *suggestio falsi* which