

begun in November 1898) it is clear that the contractors have none too much time for the completion of the whole tunnel, which must be ready by the end of May 1904—little more than 2½ years hence. For every day required beyond the end of May 1904 the contractors, Messrs. Brandt, Brandau, & Co., will be liable to a heavy fine. The stoppage of the work on the Italian side by the water is, therefore, a serious affair. On the night of September 30 the water began to rush out at the rate of 600 litres a second, transforming the tunnel into a regular canal. The Simplon Tunnel, instead of consisting of a single boring large enough for two lines of railway, consists of two parallel tunnels large enough for one line each, the two tunnels being connected by oblique transversal cuttings every 200 mètres. Thus ventilation becomes easier, and the removal of the débris is facilitated. Besides it is easier to turn off outbursts of water into one of the borings while work is pushed forward in the other. Hitherto it has not been found possible to stop the present rush of water, nor even to find out whence it comes. At first it was supposed that a mountain lake situated at a considerable height above the tunnel was the source of the water, but it was found that the level of the lake had not been affected by the supposed drainage, as it would have been if it had really been the source of the trouble. It is, therefore, supposed that the water must come from a neighbouring torrent through some unknown channel, and, in order to test this hypothesis, quantities of colouring matter have been thrown into the torrent, so as to see if the colour of the water in the tunnel is affected. Should it be the torrent will be diverted from its bed. The contractors are not yet alarmed at the mishap, because the stone through which they have recently been cutting is soft free-stone, through which they can bore at the rate of 9 yards a day, whereas until lately they had met with nothing but gneiss on the Italian side and were only able to proceed slowly.'

ACCIDENT ON THE WETTERHORN.—We regret to hear that Fritz Boss was killed early in November, when chamois-hunting on the Wetterhorn.

REVIEWS AND NOTICES.

The Bolivian Andes: a Record of Climbing and Exploration in the Cordillera Real in the Years 1898 and 1900. By Sir Martin Conway. (Harper & Brothers. 1901.)

In the latter part of 1898 Sir Martin Conway first visited the very interesting part of the Bolivian Andes, which is described in his recently published volume. His journey had three objects—to ascend one or two of the highest peaks, to study the topography of the Eastern Cordillera, and to ascertain how far the country admitted of development. To readers of the 'Alpine Journal' the order of enumeration will be that of their interest, so of the last we shall say little. Accompanied by Antoine Maquignaz, who led

the Duke of the Abruzzi in the first ascent of Mount St. Elias, and by Louis Pellissier, both of Val Tournanche, the author went from England *viâ* the 'Isthmus of Panama,' touching at Barbados, Hayti, and Jamaica, and spending a few days in the town of Panama. It was, no doubt, dull, as one of its inhabitants asserted with unparliamentary emphasis, but this was better—at any rate for the studiously minded traveller—than a revolution, in the middle of which Sir Martin had entered it eight years before. From Panama they went by sea to Callao, the port of Lima, the capital of Peru. There Sir Martin made his first mountain ascent, in a way more than pardonable under the circumstances, but not to be generally commended by the Alpine Club. From Lima a mountain railway has been constructed across the chain of the Andes, crossing the crest at an altitude greater than Mont Blanc. He went up to the watershed by train and came back in a hand car, being thus introduced to some fine scenery and novel sensations. After this glimpse of the Peruvian Andes, he resumed his sea journey, and arrived in due course at the little port of Mollendo. From this place an interesting run by railway took him to Arequipa, and gave him distant views *en route* of a snowy giant known to some as Ampato, to others as Coropuna, which is said to be 22,800 ft. high, or a rival of Aconcagua. Arequipa itself is 7,550 ft. above sea-level, and from it, had time allowed, he might have readily ascended either the volcanic Misti (18,650 ft.) or the more lofty Chachani, which is certainly not less than 19,000 ft., and may be higher.

The Bolivian Andes afford an example of a type of mountain structure which is exhibited on a grand scale in both the northern and southern continents of America—namely, a great upland plateau enclosed by two lofty mountain chains, which form an elongated loop, and thus make it a basin of inland drainage. Some geographers, we are told, regard the Andes as composed of five distinct ranges, but Sir Martin thinks the simpler structure already mentioned to be sufficiently accurate, so that the basin, including the waters of Lake Titicaca, is guarded on the eastern side by the Cordillera Real, or Bolivian Andes, as generally understood, and on the other by the less imposing Western Cordillera, usually called in the country Cordillera de los Andes. Between the two lies the great and generally rather arid plateau, or Puna, at a height of from 12,000 ft. to 13,000 ft. above sea-level. Everything is on a large scale; the two principal peaks in the Cordillera Real both exceed 21,000 ft., and are 64 miles apart. Lake Titicaca (12,516 ft.) is a hundred miles long, and averages 30 miles wide—fourteen times as big as Lac Lemán. Twenty streams discharge themselves into it; the Rio Desaguadero flows but sluggishly from it, and empties itself into Lake Poopo, from which there is no exit, at any rate on the surface. Thus the basin of Titicaca (except that its waters are fresh) corresponds in its chief physical features with the Great Salt Lake region of Utah, and it too exhibits signs of desiccation, though not to the same extent. The railway reaches

the shore of Titicaca by crossing a pass in the Western Cordillera about 2,000 ft. above it, and a steamer plies on its waters; from the southern end a rough carriage road leads to La Paz, a well-built and attractive town, the capital of Bolivia, about 12,000 ft. above sea-level. Its situation is remarkable, for it is built in a gigantic corrie, carved out of the comparatively level plateau by the headwaters of a river which runs to the south, so that La Paz lies at the foot of a steep descent of about 1,600 ft. in the vast alluvial mass by which the original area of Lake Titicaca has been restricted and the plateau built up.

The grandest portion of the Cordillera Real extends from Sorata on the N. to Illimani on the S., and as the latter peak is but a short distance from La Paz Sir Martin Conway first turned his attention to it. Its height is about 21,200 ft., but it is necessary to make a considerable descent from La Paz to reach the base. The route they followed on the lower slopes proved not to be the most direct, and three days were occupied from a farmhouse at 11,800 ft. in reaching a spot 16,500 ft. above the sea, from which the real climbing began. The delay, however, and a further one at their camp, was partly due to the inefficiency of their Indian porters, who all deserted long before the last camp was reached. This was 18,500 ft. above the sea, beyond 'the outworks of the mountain fortress,' on the edge of a lofty shelf, which commanded a wonderful view over the great plateau of Bolivia, with the volcanoes of the Western Cordillera rising in the distance beyond it. To reach the summit of Illimani from this point they had to pass over a lower eminence named the Pico del Indio, but the direct way to this was barred by a snow cornice, so they were obliged to cut steps along a great snow-slope forming its southern face. This, fortunately, was in good condition, so after a couple of hours' work they gained a saddle, which led them on to a snowy plateau at the foot of the actual summit, and about 1,200 ft. below it. Here also the snow was good, and the remainder of the ascent was merely a laborious walk across the plateau, up slopes, and along an easy snow-ridge. They reached the summit in rather more than 10 hrs. from their camp, for all had felt the effects of rarefied air. Clouds hid most of the lower region, but the view of the great snow-peaks towering above them was singularly grand. On the descent they followed a more direct route from the Pico del Indio, till they again struck their line of ascent. This peak gets its name from a story that an Indian had the audacity to invade the home of the Deity—, for that his countrymen believe the mountain to be—and was never seen again. Strange to say, Sir Martin picked up a small piece of cord such as Indians make near the top of this peak, so that, unless it was carried there by a bird—which is not very probable—there is some truth in the story.

Sorata was next attacked. This loftier mass is a group of peaks rather than a single summit, the nomenclature of which, as far as it exists, is in some confusion. The peak most conspicuous from Titicaca, 'a majestic rock tower not unlike the Matterhorn.' Sir

Martin designates Illampu, and the highest of all—'a noble crest of snow'—Ancohuma—giving the name Sorata to the mountain as a whole. Observations made on the way to La Paz had suggested that Ancohuma could be reached from an elevated snow plateau at the head of a glacier, the lower part of which was considerably crevassed. A rather tiresome journey took them in two days to the foot of the mountain. Two days more, with the help of Indian porters, enabled them to camp at a height of 18,000 ft., and another laborious day on the glacier brought them 2,000 ft. nearer the summit. Then bad weather came on and drove them off the mountain, keeping them at bay for more than a fortnight. So much snow had fallen that success was now less hopeful, but on October 10 they once more regained their highest camp. Next morning, after an early start, they reached in a couple of hours the foot of the final peak. The snow was in bad condition, the slope steepened as they ascended, and the cold was intense. At last they arrived at the edge of a huge crevasse, which extended across the slope about 300 ft. below the summit. Here they turned, for beyond that chasm they must have climbed the slope diagonally, and with the snow in that condition would almost certainly have started an avalanche, which would have put an end to the excursion and their lives. So after an attempt to find a different route, they reluctantly left the actual summit of Ancohuma untouched, though they had climbed rather higher than that of Illimani—probably to about 21,400 ft. above sea-level. But the next comer, if he finds the snow in good condition, will easily complete the ascent.

Other great peaks await the climber in the Cordillera Real. Illampu is about the same height as that which they reached. A little to the S. are three more, averaging about 20,000 ft. About half-way to Illimani is Cacaaca, about 20,500 ft., and one or two between these, though lower, overtop the highest in the Caucasus. La Paz affords an excellent base for supplies, and its authorities and the white population of Bolivia, as a rule, were kindly and helpful. The familiar difficulty about porters exists here, for the Indians, from whom they must be recruited, seem to be rather more worthless than the coolies of the Karakoram-Himalayas, and may be aggressive. In these parts the white population is very sparse and finds some difficulty in keeping the Indians under control. The latter are generally superstitious and very suspicious of strangers. Both these feelings were excited by the surveying instruments, so that attacks were more than once only just avoided, and a party of men, while Sir Martin and his guides were at the highest camp on Sorata, came to the one below with the declared intention of murdering him. Thus, in the more remote parts of the country life is not quite safe, and there is apparently no real security without a strong and well-armed party.

Besides these ascents, Sir Martin Conway succeeded in making a good sketch-map of the West side of the Cordillera Real. Two portions of this are given in his book, but the reader would have

been thankful had it included a general map of the region, such as that which the author published in the 'Journal of the Royal Geographical Society' (May, 1900). He also brought back a considerable number of mineralogical, geological, and botanical specimens. The minerals have been described in an appendix to the volume by Mr. L. J. Spencer, and they show that Bolivia possesses some that are valuable as well as interesting. The rocks, which the present writer has investigated, prove (what was previously very uncertain) that the backbone of the Cordillera Real is not volcanic, as in Ecuador and Chili, or, indeed, in the Western Cordillera, but consists of more deep-seated igneous rocks, which apparently have been intruded into and have locally metamorphosed the sedimentary deposits of which a very large part of the chain is composed. The fossils—few in number—have been described by Mr. R. B. Newton. These confirm the late Mr. D. Forbes's * identification of Devonian rocks. The author gives us some interesting geological notes, as, for instance, on the course of the La Paz river, which cuts completely through the Cordillera Real to the S. of Illimani, so that its water ultimately reaches the Amazon. Of this apparent anomaly two explanations may be offered. Either the Western Cordillera is the older chain of the two, and the river has been able to deepen its channel as fast as the Eastern one was upheaved, or the original source was on the Eastern slope of the Cordillera Real, and the river, in the course of ages, has eaten its way back through the chain and into the heart of the Puna. Of these explanations Sir Martin Conway adopts the latter. For one who has never seen the country it is difficult to pronounce an opinion, and, no doubt, rivers are sometimes guilty of trespass, as in the case of the Val Bregaglia, which has been carried back through the original watershed into the head of the Inn Valley; but, on the whole, I incline to the former view, and think the history of the Cordillera Real to be more probably a repetition of that of the Bernese Oberland and of the Himalayas. Be this as it may, the upland of Bolivia is now buried deep in débris from the Cordilleras. This in more than one place exhibits remarkable earth-pillars, concerning which there is a double slip of the pen in a sentence on p. 98, 'Alpine travellers are acquainted with earth pyramids in the Val de Bagnes and in the neighbourhood of Meran.' For the one read 'Val d'Hérens,' for the other, 'Botzen.'

On another point—the effect of diminished atmospheric pressure—Sir Martin Conway's remarks are of much interest. His experiences in Bolivia confirmed the opinion which he formed in the Karakoram-Himalayas—that after passing a level of about 16,000 ft. the climber becomes gradually conscious of an increasing difficulty in ascending or in making any other effort, but to what extent depends on the individual, the state of the weather, and other circumstances. He doubts, indeed, whether on the higher

* *Quart. Journ. Geol. Soc.*, vol. xvii. (1861), p. 7.

part of a very lofty peak climbers can expect to advance daily more than about 2,000 ft. vertical. If so, it will be a long climb to the top of Everest. In the Andes he and his guides also suffered from a kind of temporary whooping-cough at about 20,000 ft. (p. 140.) But he twice felt discomfort at a considerably lower level. On reaching a height of about 13,500 ft., in ascending by railway from Lima to the crest of the Andes, he became conscious of a slight dizziness, a tension across the crown of the head, a disagreeable excitement, a little difficulty in directing his steps, and a tingling in the soles of the feet, while many of the passengers at some distance lower down began to suffer from mountain sickness—which seems as familiar on that journey as another kind is on the Channel passage. Though he felt no discomfort in the ascent to Titicaca from the coast, ‘sorocche,’ as the complaint is called, attacked him the day after he reached La Paz. It disappeared after about twenty-four hours, but some people, he says, never get acclimatised. Hence he concludes that diminished atmospheric pressure produces, even at moderate elevations, rather more effect than is generally supposed.

But we must lay down this interesting volume. That it is well written is a matter of course; it is illustrated by many reproduced photographs, which enable us to realise not only the ice-world, but also the general scenery of the Bolivian Andes; it is excellently printed and not too large; it contains much useful information, and is a valuable addition not only to our records of mountain climbing, but also of scientific travel.

T. G. BONNEY.

Mr. H. F. B. Lynch's Map of Armenia.

We are glad to note that Mr. Lynch, following the example of Mr. D. Freshfield with regard to his map of the Caucasus, has placed the map which accompanies his work on Armenia, reviewed in our last number, on sale separately.

It is a geographical document of very great value. Although portions of the country have been mapped by the Russian staff there are many districts, and some of the most important mountain ones, in which Mr. Lynch has been able to add fresh detail and corrections. No traveller will be able to dispense with Mr. Lynch's sheet. It is a careful compilation of material derived from various sources, including the author's own travels. We do not know if he has had the advantage of the unpublished surveys said to have been made by British officers within the Turkish frontier. Our only general criticism is that had any of the modern systems of distinguishing elevations by colour been followed a much more graphic physical representation of the boundaries of the highlands and of the river basins, and more particularly of the deep trench of the Araxes, would have been obtained; otherwise the engraving is clear and intelligible.

Highland of Asiatic Turkey. By Earl Percy. (London: Arnold, 1901. 14s. net.)

The author passed through the alpine region of Hakkiari, in the north of Kurdistan, and gives good photographs of the peak of Jelu and the mountains near it—a district still little known by Europeans. The book is principally historical and political.

The River Katun and its Sources. By V. V. Sapojnikof. (Tomsk: Makushin, 1901.)

Between 1895 and 1899 Professor Sapojnikof, of the Imperial University of Tomsk, made four exploratory journeys in the range of the Altai. The journal of the first expedition was published in Tomsk in 1897, and in the present volume (in Russian) the results and discoveries of the three later expeditions are given. The Altai range, in which the Katun has its sources, is formed of gneiss and schist, and is consequently pointed and steep. The average height is about 3,000 metres. The chief summit, Belouha, was found to reach 4,540 metres (14,800 ft.), according to the author's calculations, as compared with the previous calculation by Gebler of 11,000 ft. This summit has two peaks, and in 1899 Professor Sapojnikof made an attempt to reach the saddle between them, but was driven back by a snow storm when 400 metres below it.

The book is well illustrated, and accompanied by a bibliography and careful maps, on which are shown many previously unknown glaciers.

After Wild Sheep in the Altai and Mongolia. By E. Demidoff. (London: Rowland Ward, 1900.) 21s.

The frontispiece of this work is an excellent coloured illustration of the fine mountain sheep, the *Ovis ammon*, the pursuit of which was the chief object of the author's trip. The account will interest all sportsmen, and the descriptions of the country and of the mountaineering difficulties met with in following sheep and ibex should prove interesting reading for all climbers. We think it is regrettable that the author and his friends should have slaughtered so many noble animals merely for the sake of sport, and cannot but believe that the two photographs of thirty and of seventeen heads—only part of the total bag—will give pain to every reader of the book. The text is accompanied by fairly good photographs.

PROCEEDINGS OF THE ALPINE CLUB.

A GENERAL MEETING of the Alpine Club was held in the Hall of the Club on Tuesday evening, June 11, at 8.30 P.M., the Right Hon. James Bryce (President) in the chair.

Mr. G. T. Walker was balloted for, and elected a member of the Club.

The PRESIDENT announced that Mr. W. Mathews had presented to the Club a collection of photographs belonging to the earlier