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A MOUNTAINEERING EXPEDITION TO THE HIMALAYA OF GARHWAL.*

By T. G. LONGSTAFF, M.D.

It is probably from the snowy ranges of Garhwal that the words Himaleh and Himalaya take their origin, for it is this region which is connected with the most ancient traditions of the Indo-Aryan race. From the earliest annals of Hinduism we learn that these mountains have been regarded as of the greatest sanctity, and even at the present time more merit is to be obtained by the long and toilsome journey into the heart of this "Abode of Snow" than to any other of the thousands of places of pilgrimage scattered through the length and breadth of India, with the possible exception of the sacred sites just across the border in Hundes. According to the Mahabharata, it was at Bageswar, in the Kumaon foothills, that Siva was married to Parbati, the "Mountain-born" daughter of Himachal. From her its highest summit takes the name of Nanda Devi, while the triple peak of Trisul is the "Trident" of Siva himself. In Buddha's time it formed part of the great kingdom of Kosala, which was afterwards absorbed into Asoka's empire, as is written on the "Picture Stone" at Kalsi in Lower Garhwal, the most perfect example extant of that emperor's rock-cut edicts. The pious Hwen Thsang records a visit to its shrines. A thousand years ago Sankarachariya suppressed Buddhism and restored the older Brahmanical religion, placing priests of his own Namburi clan from distant Malabar in Kedarnath and Badrinath. At the present day the Rawals of these two shrines are drawn from the same locality. Almost every natural feature of the country is connected with some event of ancient

* Read at the Royal Geographical Society, January 27, 1908. Map, p. 472.

PART OF THE GARHWAL HIMALAYA

constructed from a plane table survey by
HAVILDAR DAMAR SING RANA (5th Gurkha Rifles)
and from photographs by
Mr A. L. MUMM AND Dr T. G. LONGSTAFF
based upon
the trigonometrical points of the Survey of India.

Scale 1: 250,000 or 1 Inch = 3·94 Stat. Miles.
0 5 10

Heights determined by Dr T. G. Longstaff, by boiling point and aneroid, are shown thus 16140
Route in 1905 shown thus .....
" " 1907 " " .....
Heights in feet.

Scale 1: 6,000,000 or 1 Inch = 94·7 Stat. Miles.
50 0 50
Route

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or mythical times. Thus, apart from other reasons of geographical position, it is not surprising to find that the great peaks are known by distinctive and widely recognized names of ancient origin, a condition of things by no means universal in other mountain regions. This region, too, is far more "alpine" in character than the icy solitudes of the Karakoram and Baltistan, and contains a rich and interesting flora and fauna.

The snowy ranges of British Garhwal, containing some forty triangulated peaks of over 20,000 feet, are roughly divisible into three groups. The first, representing an axis of elevation considerably to the south of the present water-parting, centres round the twin peaks of Nanda Devi, 25,660 and 24,379 feet—strictly speaking, the highest mountain within the British Empire. This group is most complicated and irregular in structure, but may be briefly described as being bounded on the west and north-west by the valleys of Alaknanda and Dhaoli rivers; on the north by the valley of the Girthi and the Milam peaks; on the east by the Milam valley; and on the south by the Pindar. Thus it will be seen that considerable portions of the eastern and southern slopes lie in Kumaon. The second group, a prolongation of the same axis of elevation, fills the angle formed by the valleys of the Alaknanda and the Dhaoli. Its highest peak, Kamet, 25,450 feet, is situated a mile to the south of the Tibetan frontier, in which country its northern slopes lie, the main axis of elevation thus articulating with the present water-parting, though it must not be forgotten that the streams rising from the Tibetan slopes flow into the Sutlej, and thus eventually reach India. In that corner of British territory to the east of the Kamet group, and to the north of the Nanda Devi group, lies a lofty but far less snowy area, whose physical and geological character approximates to that of the adjacent portions of Hundes. The third group really belongs to Tehri-Garhwal, and centres in the peaks around Gangotri; but the glaciers of its eastern slopes discharge their waters into the valley of the Alaknanda. The latter have never, as far as I can ascertain, been examined by Europeans, though the glaciers of Gangotri are fairly well known.

These steep-sided river valleys supply a number of natural routes by means of which it is relatively easy to penetrate into and beyond the barrier of the snows, and thus Garhwal has for many years been annually visited by British sportsmen, in addition to the thousands of natives from every part of India who have for generations performed the sacred pilgrimage, and to the Bhotias who trade over into the Tibetan territory of Hundes. Yet such is the inaccessibility of some of the lateral gorges, that in many places the glacier regions still remain untouched. The sportsman has no object in climbing above the snow-line, and it is only in very exceptional cases that the native can be induced to do so. Thus when they came to the snow-line, the officers of the Survey of India had

a problem of the greatest difficulty before them, which was further complicated by climatic conditions limiting their season to a few months at the outside. I have nothing but admiration for their work, and especially for that of Mr. E. C. Ryall, Assistant-Superintendent G.T.S., who carried out the Kumaon-Garhwal survey during the years 1874 to 1877. It is not surprising that there are errors in the delineation of the glacier regions, but it is surprising that men who had no training in what mountaineers call snow-craft should have gone where they have gone, and made such good maps of those parts of the country to which neither they nor the natives could gain personal access. And it is evident that they did not shirk difficulties, for it is casually mentioned in the Survey Report for 1874–75 that Mr. I. S. Pocock reached a height of 22,040 feet from the Mana valley, though there is no record of the actual spot reached.

In the first half of last century Traill and the Stracheys penetrated well above the snow-line. In the fifties the Schlagintweits visited the Milam glaciers and the Kamet group, where they reached a height of 22,259 feet on the Tibetan side. For many years Colonel E. Smyth, who selected Nain Sing and Kishen Sing for the Tibetan survey, made very high excursions in the course of his annual shooting trips. In 1883 Graham made the first purely mountaineering expedition amongst these snows, reaching heights of over 22,000 feet in the Nanda Devi group, and being the first to penetrate far into the mysterious valley of the Rishi Ganga. This expedition still constitutes the most successful ever recorded in the annals of Himalayan mountaineering, but its occurrence just a quarter of a century before public judgment in India was ripe for its appreciation, and Graham's own lamentable carelessness in writing the extremely condensed accounts* of his experiences, have combined to give an excuse for doubting the accuracy of his statements which has been seized upon by critics sometimes too much interested to be wholly impartial. As a rule the latter have passed over his first visit to Sikhim and his visit to Garhwal, confining themselves to disputing the ascent of Kabru during his second visit to Sikhim. But for the reputation of the Alpine Club—to which, be it noted, Graham never belonged—it is pleasant to record that he never lacked partisans amongst the most eminent and experienced of its members.

I first visited these mountains on my return journey from Tibet in 1905, details of which have already appeared in the *Geographical*† and *Alpine*‡ *Journals*. Last summer Major the Hon. C. G. Bruce, 5th Gurkha Rifles, Mr. A. L. Mumm, and myself, hoped to celebrate the Jubilee of the Alpine Club by attempting the ascent of Everest, or at

* *Proc. R.G.S.*, New Series, vol. 6; *Alpine Journal*, vol. 12; *Good Words*, 1885.
† *Geographical Journal*, vol. 29, pp. 201–211.
‡ *Alpine Journal*, vol. 23, pp. 202–228.

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least the exploration of its unknown glaciers. In this scheme we received the most generous and cordial support from the President and Council of this Society. When we were peremptorily forbidden to enter Tibet by the Home Government, I was able to persuade my friends to join me in an expedition to Garhwal, the chief object of which would necessarily be mountain climbing rather than geographical exploration. This must be my excuse for the smallness of the geographical results which I am able to place before you. Nowadays there is only room for the specialist in the various branches of geographical investigation. The only specialty to which we can lay claim is snow-craft.

Besides ourselves, the party consisted of the guides, Alexis and Henri Brocherel, of Courmayeur, who had accompanied me on my previous expedition, and Moritz Inderbinen, of Zermatt, who had been Mumm's companion for over twenty years, and with him and Freshfield made a recent attempt on Ruwenzori. Owing to the great kindness of Colonel A. H. G. Kemball, of the 5th Gurkha Rifles, Bruce was able to bring from this regiment Subhadar Karbir Burathoki, Havildar Damar Sing Rana, and seven riflemen, mostly Magars and Gurungs. Damar Sing was a trained plane-tabler, had charge of the stores, and kept the accounts. Karbir counted as a guide, for he had climbed a good deal with Bruce in Kashmir and the Karakoram, and also with Sir Martin Conway in the Alps. The others, though accustomed to run about quite regardless of the accepted laws of gravity, were as yet ignorant of the higher mysteries of mountaineering. But to men trained in such a regiment this was of no consequence. They never failed us, they never complained, and they never lost their cheerfulness. Without them we could have done very little. They were superior to the best Garhwalis I have met, and even to the Bhotias, so I need hardly add that they bore no resemblance whatever to the Kumaoni or the down-country native.

Bruce also brought a single servant as cook, and undertook the entire organization of the commissariat and Gurkhas' outfit, while Mumm and I were still in England. We joined him with the guides at Almora on April 24 and got away on the 26th, crossing the Pindar river beyond Gwaldam on the 28th, after a 50-mile march through the Kumaon foot-hills.

We pushed on rapidly across the three intervening ranges of the middle hills, the zone of the pine, the oak, the rhododendron, and the fir. Snow was still lying on the ground in the upper forests, which are very beautiful, and from which most exquisite views of the high peaks to the east and north are obtained. Our route lay by Wan and Kanol to Ramni, where we picked up the stores which Bruce had sent on in charge of Karbir; then down to the Bireh Ganga and up the other side to Kaliaghat (Pana), passing above the remains of the Ghona lake formed by the great landslip of 1893; and so over the Kuari pass, 12,400 feet, to

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Tapoban on the Dhaoli, which we reached on May 5, having covered another 50 miles. From the Kuari pass, still deep in snow, we saw the wonderful panorama of peaks stretching from beyond Badrinath right round to Dunagiri, and, thanks to the weather and an early start, we obtained some excellent photographs. On this occasion we required one hundred and fifty coolies to carry our baggage and the six months' supplies for the whole party which we were taking with us. Had it not been for the assistance of Mr. V. Stowell, I.C.S., the Deputy Commissioner for Garhwal, and to Bruce's forethought, we might have lost many valuable days on this part of our journey.

Our first objective was the Rishi valley, by means of which we hoped to find a practicable route for the attack of Trisul, 23,406 feet, the second highest peak of the Nanda Devi group, my visit in 1905 having shown that there was no practicable route on the south or west. This valley, though well wooded, and some 20 miles in length by 15 in breadth at its broadest, has never been permanently inhabited, but receives an annual two months' visit from the Tolma shepherds. The Rishi Ganga bursts into the Dhaoli at the hamlet of Rini, 6000 feet, but so narrow and precipitous is the gorge that Graham's party was the only one which had penetrated far up it. Mr. E. C. Ryall, in his report on the work of the assistant-surveyor who entered it in 1874, dwells on the "great exposure and privations in the Rishi Ganga valley, the survey of which is perhaps the most formidable undertaking in the whole range of the Himalayas yet accomplished."

The name "Rishi" applies firstly to the seven "mindborn" sons of Brahma, now represented by the seven stars of the Great Bear, and to whom the Vedic hymns were revealed; secondly, it comes to mean an inspired solitary sage, or hermit, as near as I can translate it, and it is easy to understand that the mystery with which this valley is surrounded and the awe with which it is regarded led to a belief in the existence of such supernatural beings within its inaccessible recesses, and to the bestowal of the name. I had hoped to try the route by the valley for myself, but the river was swollen with the melting snows, and the local people declared that it was impossible for laden coolies to get along it. There is, however, a back door into the upper part of this valley, known to the Tolma shepherds, by which it has been entered by a single surveyor, a few native shikarris, and by three or four determined sportsmen, none, however, having got nearly as far as Graham with the exception of Mr. A. P. Davis, from whom I was able to get some idea of the topography. From Tapoban our heavy camp and stores were sent on to Surai Thota (*surai* = *Cupressus torulosa*) (7290 feet),* with some of the Gurkhas, to wait—as it turned out—until June 19. After spending several days on the slopes above the hamlet

* *Vide* Notes.

of Lata, and reconnoitring the cliffs along which our route must lie, we regretfully came to the conclusion that, owing to the depth of the snow, it was at present impossible to take coolies across with the necessary three weeks' supplies, so we decided to pass on for the present up the Dhaoli and Dunagiri valleys to the Bagini glacier beyond the village of Dunagiri, and to the north-east of the peak of that name, our main depôt still remaining at Surai Thota. On May 15 Bruce established our temporary base camp (12,850 feet) at the foot of the Bagini glacier, on a level with the last rhododendron and birch trees. According to the G.T.S. (? 1874), the Bagini glacier must have receded about half a mile; it now terminates at about 13,700 feet. The Dunagiri glacier of the G.T.S., flowing down from the north, does not now join it, but ends above a steep slope covered with moraine stuff close to the spot marked 14,237*b* on the G.T.S. I started Damar Sing with the plane-tabling, and we reconnoitred the upper part of the glacier basin together. As we had hoped, there seemed to be a strong probability that a mountaineering party could force their way into the Rishi valley, over the ridge between the G.T.S. peaks A_{21}, 22,516 feet, and Dunagiri, 23,184 feet, and get out lower down. We also hoped to learn something of the route to Trisul, for this was really unexplored country; so we decided on this course instead of trying a peak, of which there is a considerable choice hereabouts.

On May 20 the six Europeans, with Karbir, Kulbahadur, Buddhichand, and Dhan Lal, started up the Bagini glacier, taking eight coolies to carry loads. We camped (15,500 feet) on the right lateral moraine, sending the coolies back at once. Next morning (May 21) we pushed on up the Bagini glacier, and then turning almost due south, at our first plane-table station (16,140 feet), we continued along the main course of the glacier which, flowing from the direction of Dunagiri Parbat, sweeps round towards the north under the two peaks of A_{21}, 22,735 feet and 22,516 feet, locally known as Kalanka and Changabang respectively. The latter is the peak ascended by Graham in 1883, and named by him "Mount Monal." It is worth recording here that the bestowal of this name, after the *monal* pheasants that he saw "on its slopes," has been urged as a proof of Graham's unveracity. But how can any one imagine that he meant he saw them on the summit, or even above the snow-line? In his more detailed papers in *Good Words*, he explicitly states that he saw them between his camp on the banks of the Rishi and his final bivouac—a locality in which they abounded at the time of our visit. Changabang is the most superbly beautiful mountain I have ever seen, its north-west face, a sheer precipice of over 5000 feet, being composed of white granite with a pale pinkish tinge, so that it is at first mistaken for snow lying on the cliffs at an absolutely impossible angle.

All who were bound for the pass were heavily loaded, as we had

Dr. T. G. Longstaff, Photo.

CHANGABANG (22,516 ft.) FROM THE BAGINI PASS.

to carry Primus stoves, petroleum, cooking-pots, tents, sleeping-bags, instruments, rifles and ammunition, a large supply of ropes, and provisions sufficient to last our party of eight for ten days. For, having got into the Rishi valley, we intended to get out of it some time. In the interval we must be self-supporting. The sun was so oppressive that after tramping over the snow for five hours we stopped, at 11 a.m., under the shade of some huge blocks which formed part of an irregular medial moraine (18,300 feet). Instead of making for the pass directly under Changabang, we had now decided to go right up to the head of this arm of the glacier, more directly under the great easterly spur of Dunagiri. Mumm was not going to cross the pass with us, and returned to the camp above Dunagiri with Inderbinen and Dumar Sing, leaving us a party of four Europeans and four Gurkhas. He rejoined us later at Surai Thota.

On May 22 we started at 4.30 a.m., but Bruce and I had very soon to stop with cold feet, and it was probably at this time that Karbir got his frost-bite. We had to rope over the last slopes, and the guides cut many steps. Our loads seemed to grow inordinately heavy, but at 10 a.m. we stood on the crest of the pass. Its height comes out at 20,100 feet, and the name Bagini pass would most naturally belong to it.

From the pass we looked down to a vast *firn*, shut in by snow-clad peaks, while 3000 feet above us on the west towered the icy crest of Dunagiri. But the descent of the south side looked so bad that we had to set about it at once. The Brocherels had brought a good supply of iron *pitons* from Courmayeur, and, by means of fixing these into cracks in the rocks and doubling ropes round them, we were able to lower ourselves and the loads down the snow-draped cliffs below us. It really was a difficult bit of mountaineering, the descent of about 1000 feet occupying over five hours, and the two Brocherels were quite in their element. This was a very fine performance on the part of the Gurkhas, and a striking testimony both to their inherently resolute character and to the excellence of their military training. Remember that they were called upon to perform a feat which was quite beyond the powers of any of the local men. As an instance of the value of local native evidence, I may mention that Mr. J. S. Ward, of the Rifle Brigade, told me that less than three months later our route was pointed out to him as lying over the spurs to the *west* of Dunagiri, along a shepherd's summer track. We had disappeared from the neighbourhood of their village and reappeared eight days later at Surai Thota. Obviously, then, we went by the only route they knew of!

We were very glad to camp about 4 p.m. on the snow-field directly at the south foot of the pass (18,800 feet). After a painfully cold night we got off at 6 a.m. on May 23, and proceeded down a huge snow-covered glacier in a south-easterly direction, with the twin peaks of

Nanda Devi showing over the ridge straight ahead of us, and then, turning a sharp corner in a south-westerly direction, leaving the magnificent cone of Changabang behind us. In six hours we reached the end of the glacier for which the name Rhamani or Arhamani was afterwards given us by a *shikarri* whom we took to the foot of the Trisuli Nala, from the slopes of which it is visible. He said that neither he nor any one else had ever been there, though Graham must have touched it, and I don't know that there is any authority for the name. We had fondly hoped to find ourselves on the great glaciers at the foot of Nanda Devi itself, but the G.T.S. is naturally very inaccurate here. The glacier ended in a steep tongue covered with a horribly unstable litter of moraine stuff.

We next came to an extraordinary gorge cut out by the glacier stream, which was often quite invisible, though very audible, under thick beds of hard snow. In one place we had to lower our loads on the rope, and follow ourselves in a similar manner. After food and a short rest, we broke out of the gorge to the right, climbed up the steep slopes on the west, and down again to the first patch of birch trees, where we camped at 6 p.m. (13,100 feet) amongst enormous boulders, which still held some snowdrifts from which we could get water. To the east towered the cliffs of Nanda Devi, too steep to hold the snow. South was the entrance to the Trisuli Nala, though the peak itself was invisible. Directly at our feet, more than 1000 feet below, lay the junction of the Rhamani and Rishi torrents.

We started late on May 24, after a most refreshing night, and skirted high up along the slopes that fall in one continuous sweep from the peak marked "Niti, No. 3, 17,056 feet" on the G.T.S., into the Rishi Ganga, here only 10,900 feet. There is thus a drop of over 6000 feet in a horizontal distance of 2 miles, while the slopes of the opposite south bank of the Rishi are very much steeper. After only a couple of hours of this work we saw some *bharhal* (*Ovis nahura*) below us, and killed two, after an easy stalk. Much to the wrath of the guides, we decided to stay where we were and eat them, so we camped under an overhanging cliff, near a convenient supply of juniper bushes and snow. For May 25 I noted a "really terrific dry coasting along the slopes of Niti peak (No. 3, G.T.S.), at about 13,000 feet." We were all well loaded, and the strata being the wrong way, we were constantly toiling up steep slopes to avoid difficulties, only to find horrid cut-offs on the other side. This lasted from 7.30 a.m. to 5 p.m., by which time we had covered 2 miles in a straight line, when, after a particularly heart-breaking ascent, we came upon a most unexpected sight. In a deep lateral nala far below us was a thick forest of tall, straight pines surrounding a small grassy alp. For five days we had had to rely on snow for drinking purposes, and at only the two last camps had been able to get any wood, so this was a very welcome change. We afterwards found

that this was the summer pasture, named Dibrugheta (11,730 feet from six observations), to which the Tolma shepherds annually bring their flocks. The alp is less than half a mile south-south-west of the spot marked 14,710*b* on the G.T.S.; this is probably an error, though it appears to indicate the furthest point reached by the surveyor in this direction.

On May 26 we started rather late—at 7.45 a.m.—to make our way past the screen of bare cliffs, which, towering 2900 feet above us, completely shut in the *nala* on the west. We kept at first to the left bank of the stream, and rapidly gained height by following the crest of an old lateral moraine. Standing on this irrefutable witness of the former presence of glaciers, it was interesting to observe that this narrow and steep-sided glen was truly wedge-shaped in section, and now showed no signs of glacier activity, even on the exposed rock-faces opposite, other than the presence of the moraine itself. At the head of the glen, however, is a small hanging valley, the old glacier having doubtless here made a stand in the course of its retreat, and so inhibited the cutting-back action of the stream. Three weeks later, when *thar*-shooting, I followed the glen with great difficulty right down to the Rishi Ganga, and, from what I saw, came to the conclusion that Dibrugheta itself may represent a terminal moraine, but that this ancient glacier had never descended below that spot, unless we argue that the torrent may have obliterated all traces of it.

Crossing the torrent about 1½ miles above Dibrugheta, we climbed up the steep grassy slopes, still snow-covered, and crossed the ridge at over 14,000 feet. Gentle snow-slopes led us on at 2 p.m. to three stone goat-pens half buried in snow. This was Durashi (13,230 feet from seven observations); it is close to the spot marked 12,950*b* on the G.T.S., so we knew we must be on the right track. The highest peak of the "Curtain" between Durashi and Dibrugheta was afterwards found to be 14,630 feet, and its lowest depression 14,100 feet. From this little peak, and from the top of a cliff a quarter of a mile to the west of our camp, we obtained most extraordinary views down a series of appalling precipices to the bed of Rishi Ganga far below us. From Lata peak, 12,624 feet, G.T.S., on the other side of which we had encamped a fortnight earlier, the drop to the river must be nearly 6000, and this in a horizontal distance of only three-quarters of a mile.

We still had to find the whereabouts of the goat track across the cliffs ahead of us, and when we left camp next morning (May 27), at 6.30 a.m. in cold wet mist and falling snow, we realized that we were in for some interesting work. We started up the slopes to the north-west and tried the cliffs in several places, but, owing to the mist, failed to hit off the route. However, after some good climbing, we found ourselves at 10 a.m. on the summit of a small peak (15,700 feet). We christened this Tolma peak, because we believed that if we went down the further

side we should reach the village of that name. It was snowing and blowing, and the descent of the steep snow gullies below us called for great care and all the usual precautions. Fortunately, the angle gradually eased off, and we were able to unrope and glissade down an old avalanche which took us right into the forest at the head of the Tolma glen. We then raced off down this densely wooded gorge, sometimes in the bed of the torrent itself, but more often creeping along the cliffs on its left bank, and so through Tolma village to our base camp at Surai Thota, thoroughly well satisfied with our eight days' expedition.

Bruce had, most unfortunately, damaged his knee during our passage down the Rishi valley, and it now became so painful that he was compelled to lie up. But the rains were approaching, and the assault on Trisul still to be made; so with his generously given consent we decided to leave him at the base camp at Surai Thota, with his servant and four of the Gurkhas. On May 31, Mumm and I set off with the three guides, Karbir, Damar Sing, Kulbahadur, Dhan Lal, Buddhichand, and also a young shikari, with twenty-three coolies to carry in our supplies for three weeks. We mounted the steep track to Tolma village, and then turned straight upwards into the forest past some magnificent deodars, one of which measured 41 feet in circumference 6 feet above the ground. The woods were full of *monal* pheasants, and we found a nest with six eggs in it. Early in the afternoon we camped on a pretty little alp known as Hyetui Kharak (11,500 feet).

We were up at 5.30 on June 1, but could not get the coolies off till 7 a.m. Soon after the tree limit (12,000 to 12,500 feet) had been passed, the guides commenced the arduous task of breaking a track through the snow for the coolies, who required the help of the rope to get round one particularly awkward corner. At 12.30 we reached the *col* (14,700 feet), and commenced the passage of the cliffs leading to Durashi. The guides had to cut every step of the way, while we and the Gurkhas helped the coolies over the worst bits. The goat track should have been clear by now, but, as I have said, the season was a late one, and every ledge was covered by a steep slope of snow. Fortunately no one slipped, and soon after 3 p.m. we reached our old quarters at Durashi. Next day we crossed the "Curtain" ridge, dropped down 2500 feet to the stream at its foot, and so reached Dibrugheta.

On June 3 the coolies got off before 7 a.m., as we had told them that this would be their last march. Crossing over an intervening spur, we struck down diagonally over very bad ground, below the slopes we had traversed on May 24 and 25, to the Rishi Ganga, making for a spot called Duti (10,900 feet). Here some huge boulders in the bed of the torrent made it easy to construct a temporary bridge, which we crossed about noon. We were now on the south side of the Rishi Ganga, and the opening of the Trisuli Nala—as we named it—was only a very short

distance further up the stream. But there is, of course, no sign of a track, and we had to climb up 1500 feet before we could turn east along the densely crowded thickets of rhododendron and birch which clothe the sides of the valley. However, soon after 3 p.m. we found a fairly good camping-place in the bed of the Trisuli Nala itself, amongst a tangle of birch trees, and just on a level with the last of the pines. This camp (11,600 feet) was to be our base for Trisul, so we paid off all but three of the coolies and sent them back to their homes, with instructions to return in three weeks if they felt inclined, but that we were quite independent of their services. This last statement, though true, was made merely to ensure their return.

On June 4 Damar Sing climbed up the steep crags on the right bank of the stream with the plane-table, while I went up the opposite slopes to get a look up the *nala*. Very soon I saw a glacier with a series of moraines on its left bank, which came sweeping into our *nala* from the south-west almost at a right angle. Soon after gaining this, about noon, I saw three *bharhal* crossing the ice, and shot a couple for food, which I think was allowable under the circumstances, and considering that only one sportsman, Mr. A. P. Davis, had ever been here. His camping-place was pointed out to me by the shikari, who called it Betatoli, which name I therefore attach to the glacier. It heads from the north-eastern slopes of the G.T.S. peak 20,842 feet, $4\frac{1}{2}$ miles north of Trisul. Its middle course is broken by a formidable ice-fall. Formerly the Trisuli glacier flowed into the Betatoli glacier from the south, and deflected the latter towards the north. Now that the Trisuli glacier has receded, the Betatoli has straightened itself out, leaving a series of lateral moraines along its left bank. Further, it has completely blocked up the Trisuli Nala, impinging against the cliffs of its eastern wall, and presenting to the south an almost perpendicular face of ice several hundred feet high, in the base of which the Trisuli torrent has carved out an ice-tunnel. The snout of the Betatoli descends just below the level of the birches and rhododendrons to about 12,400 feet, and showed no signs of recent recession.

It did not seem worth while to carry our base camp any higher, so we decided to leave Damar Sing in charge to carry on the plane-table survey, and to wait for Bruce with the shikari and the three coolies who had elected to remain with us. On June 5, I set off with Mumm, the three guides, Karbir, and the three other Gurkhas; we carried the lightest possible outfit—four Mummery tents weighing about 4 lbs. each, and eider-down sleeping-bags for the whole party. We followed the left bank of the stream straight up the Trisuli Nala, and then took to the left lateral moraine of the Betatoli glacier. After following this till the ice became less steep and broken, we crossed the glacier at right angles, scrambled up the moraine on the right bank, and dropped down into an unexpected little hollow on the far side. Its floor consisted of

old moraine heaps thickly carpeted with coarse grass and juniper scrub about 2 feet high. It was a pleasant and well-sheltered spot, obviously the last at which we could camp in any comfort, so, although it was only 11 a.m., and our altitude only 13,100 feet, we decided to stay here. Amongst ourselves we always called it "Juniper Camp."

After caching some tins and *bharhal* meat in a bed of snow, we started at 6 a.m. (June 6) up the moraine-covered slopes leading to the Trisuli glacier. Keeping well up the left bank of the Trisuli torrent, we reached the snout of the glacier at about 14,000 feet at 8 a.m. It is at present rapidly receding. I noticed that the black gneiss cliffs on the opposite (right) side of the glacier were seamed with beautiful veins of white, which I took for quartz. As we went on, the left lateral moraine grew more and more distinct, and soon its crest offered us an excellent path. At first it led us due south, but soon we began to bend round slightly to the south-west. Straight ahead were A_{29}, 22,490 feet, and A_{29}, 22,360 feet, and closing in our view up the glacier on the west were some high black cliffs festooned with icicles. Then we saw our moraine (left lateral) taking a sharp turn to the west, and, climbing up the mountain-side, disappear amongst snow and ice. At the same moment we saw the great gap between A_{28} and the middle peak of Trisul. I had reconnoitred its dangerous southern side from the Kurumtoli (Garhwali-Kail) glacier in 1905, when I pointed out the mistake in the G.T.S. Three months later on I was again to find myself on the south side of the range, and to discover that the Sukeram glacier was also wrongly delineated. Yet I must admit that the mountain grouping is here so complex, and the access to these glaciers so difficult, that the only wonder is that we have any maps of them at all.

We went on up to the last slope of the moraine that was free from snow and camped at 2.30 p.m., at a height of about 16,500 feet. This is the highest point at which I have seen any plants or grasses in this part of the Himalaya, though further north they extend very much higher. In front of us, as we looked towards the invisible summit of Trisul, was a magnificent ice-fall, and above that huge rolling wastes of desolate snow. Starting at 5.30 a.m. on June 7, we continued to mount in a westerly direction, having this ice-fall on our left hand, and a line of dark cliffs on our right. The slopes were steep at first, and our loads kept the pace down. On reaching the open snow-fields above, the sun became very trying, and I felt the exertion severely. About noon the slope steepened again, and a violent west wind began to blow, so at 2 p.m. we camped at an altitude which works out at 20,050 feet. The surface of the snow was whipped up and driven into and through our clothes apparently from every direction. We managed with great difficulty to persuade one of the Primus stoves to work, and Henri gave us all a hot drink. I turned in with Karbir, who watched over me like a nurse, although he was suffering considerable pain from the frost-bite

he had contracted on the Bagini glacier. We passed a cold uncomfortable night, owing to the violent wind and the snow which was driven into the tents. Next morning, June 8, the gale was still raging. The tents, though only 3 to 4 feet high, could hardly be kept standing, and it was quite impossible to make a start. As Inderbinen was suffering from very severe headache, and the three Gurkhas were feeling the cold acutely, though without complaint, we decided to send them down to Juniper camp on the first sign of a lull, which came about noon. The rest of us stayed on in the hope that things might improve by the next morning. We could not stay outside the tents, so I passed the day in smoking and dragging out Karbir's reminiscences of war. He has been in forty affairs, and is great on bullet-wounds. He takes a sensible view of war, and fights to hurt. I fear Mumm had a very dull time alone in his tent. We could not even melt snow to drink, though the guides tried for more than an hour. The second night seemed worse than the first, and a lot of snow had driven into the tents by morning, so we literally tore ourselves up by the roots and struggled down through the bitter cold weather. We got out of the wind as soon as we neared the line of cliffs by the ice-fall, and leaving some things at our old camping place, we trudged back along the moraine to Juniper camp, which we reached at 2.30 p.m.

On June 10 we enjoyed a well-earned rest and the comforts of a fire, and although it snowed from 1 to 5 p.m., we felt very luxurious. Fearing for Karbir's frost-bitten foot, I tried to persuade him to give up the attempt, which we decided to renew on the morrow. But it was useless, as Bruce had warned me it would be, so we made some *bharal* skin covers for his boots, which we hoped would help to keep out the cold. Mumm had severe indigestion all night, and was so unwell in the morning that he decided to return to the camp in the Trisuli Nala. It was extremely hard lines, for he had had all the hard work and discomfort so far, and he stood high altitudes so well that he could certainly have reached the summit with us. So, to my great regret, we parted on June 11, with his most strict injunctions to get to the top somehow. I had with me Alexis and Henri Brocherel and Karbir. Dhan Lal and Buddhichand came with us for the day to carry my load and lighten that of the guides. Leaving Juniper camp at 6.20 a.m., we reached our moraine camp of June 6–7 very quickly at 10.50. All the morning the weather looked very arctic, but the absence of sun probably accounted for our excellent pace on the way up the moraine. At about 15,000 feet we put up several ram-chickor (*Tetraogallus tibetanus*), and saw a couple of very dark-coloured foxes. After much discussion with the guides, I had come to the conclusion that our best chance was to rush the peak from a lower camp, and not to tempt the wind again on the exposed snow-slopes higher up. Snow began to fall at noon, and soon afterwards we sent the Gurkhas back and pitched our two Mummery tents

at about 17,450 feet, under the shelter of the high cliffs already mentioned. We immediately set to work with the Primus stove, and after a long drink all round, we filled three large "thermos" bottles with cocoa and weak tea. In this way we hoped to provide a breakfast drink and enough liquid for the ascent, without having to waste several hours over snow-melting the next morning.

Snow continued to fall gently till the early hours. We tried to start (June 12) at 4 a.m., but I could not face the cold, which attacked my feet and hands before I could get my frozen boots on, although I had kept the latter inside my sleeping-bag all night. However, we started at 5.30 a.m., and as we carried only the very lightest loads we made very rapid progress. We reached our old upper camp (20,000 feet) by 10 a.m., where we remained half an hour to eat a small meal of raisins and plasmon biscuits, for we had all fully realized that it was most unwise for us to try and negotiate a heavy meal at such an altitude. Seeing signs of crevasses ahead, we put on the rope, Alexis leading, then Karbir, Henri, and myself. Then on we went up the snow-slopes, of continuous steepness but withal quite easy. My breathing was very rapid, and I felt very feeble, but I was securely tied on to the rope and could not escape. The *tourmentes* of wind-driven snow, to which this slope of the mountain seems very liable, were at times almost paralyzing in their intensity, yet I am sure that we bore the cold better than we should have borne extreme heat. At noon we found we had reached 21,000 feet, and here Alexis had to take off the small snow-shoes, with which he had been breaking a track through the crust of new snow, as the slope steepened again. I should mention that our route lay south-west by south all day after leaving the site of the upper camp. I began to doubt my capacity for maintaining the pace much longer, but Alexis and Karbir seemed quite happy, and Henri offered to pull on my rope as much as I liked, so I pocketed my pride and consented to this breach of the rules. Except for the briefest halts to recover my breath, we now rose rapidly and continuously, the slopes being at that particular angle of steepness which enables the climber to make height most rapidly, and all the peaks in sight sank below us, except Nanda Devi. As we neared the summit the bitter west wind again swooped down on us, rattling the icicles on our beards and moustaches. At 4 p.m. we emerged on to a flat-topped dome of snow. This forms the apex of the huge triangular snow-field which is set at a steep angle upon the north-east face of the mountain, and along the western edge of which we had climbed. Henri hailed it as the summit, and, driving his ice-axe into an incipient crack in the snow, planted the stick and square of canvas he had insisted on bringing up. But I was not yet satisfied, for just beyond us, across a dip in the ridge, was a most provoking cornice, which cut off the view to the south. Excitement made me lose all sense of fatigue, and I pushed on, the tail thus leading the head. Not knowing the size of the cornice,

VIEW NORTHWARDS FROM THE SUMMIT OF TRISUL.

Dr. T. G. Longstaff, Photo.

that is the extent of its overhang, I had to keep well down on the western slope. The snow was frozen hard, and the crampons I was wearing bit well; however, the rest of the party were not wearing these "adventitious aids" that day, and I was ordered to cut steps. The distance was very short, and I soon crawled on to the cornice and looked over the edge, Henri hanging on to the rope in case of accidents. The first thing I noticed was that Henri had been quite right in insisting on the first peak being the highest, but I would not have missed the view down that astounding southern precipice for anything. Over the foothills was a dense copper-coloured haze—a dust-storm from the plains—but to the west I seemed to be gazing into endless space. I cannot describe that view, but the memory of it remains my most treasured possession.

The cold was very trying, and, turning back almost at once, we left the first summit at 4.30 p.m. I felt quite done up, but had no difficulty with my breathing as soon as I began to go downhill. Going very fast, we reached our camp under the cliffs at 7 p.m.; but perhaps my watch was fast, for it was so light that the men insisted on rolling up the tents and sleeping-bags, and carried everything down to our old camp on the moraine at 16,500 feet. That night my only desire was for sleep; I was neither hungry nor thirsty, though I had taken very little all day.

I hope I have made it plain that the two Brocherels, to whom all the credit of the ascent is due, and Karbir showed no signs of distress during the climb. We ascended from a camp at 17,450 feet to the summit, 23,406 feet—that is to say 6000 feet, in ten hours. Graham estimated his highest camp on Kabru at 18,500 feet, and reached the summit, 24,000 feet—an ascent of 5500 feet—in a little over nine hours. In each case this gives a rate of approximately 600 feet an hour. Turning to the Alps, the best instance I can remember for comparison is the ascent of Mont Blanc, 15,781 feet from the Dome Hut 10,499 feet on the Italian side. I have twice performed this ascent of 5282 feet in five and a half hours, which gives a rate of 960 feet an hour. In addition to this diminution of progress, I am distinctly conscious of both mental and physical lassitude at very great altitudes; but I have now been to 20,000 feet and over on about ten occasions, and slept at least three nights at such altitudes, and my experience confirms me in the belief that the effect of low atmospheric pressure depends on the strength and condition of the climber much more than on the actual altitude he attains.* I also believe that the idea of acclimatization to low pressures is fallacious, for in my experience the effects are cumulative; and it was this consideration which finally decided me to rush the peak from a comparatively low camp.

* *Vide* 'Mountain Sickness and its Probable Causes.' By the writer.

Next morning (June 13) Alexis and I proceeded up the level snow-covered surface of the Trisuli glacier for one and a half hours; while Henri and Karbir started back down the glacier with heavy loads. Ahead of us lay the Trisul Gap, as I would name it, for, having never been crossed, it can hardly be called a pass. It has the appearance of being less than 18,000 feet in altitude, and is situated in the great ridge which runs from the middle peak of Trisul (? about 22,000 feet) in an easterly direction through the peaks A_{28} and A_{29} of the G.T.S. The map therefore misplaces this water-parting between the Pindar and the Rishi by about 2 miles, showing the ridge as articulating with the highest (northernmost) peak of Trisul.

Returning down the Trisuli glacier, we redistributed our loads at Juniper camp, which we had looked on as our home since June 5, and proceeded across the Betatoli glacier and down to our base camp at the mouth of the Trisuli Nala. Here we were welcomed by Bruce and Mumm, the former having sufficiently recovered to come over into the Rishi valley, but being now down with fever, so that it was impossible for him to attempt to repeat the ascent of Trisul. It will always be a source of great regret to me that neither of my companions were able to share in this ascent. We all worked together during the expedition, but I think Bruce worked harder than the rest; certainly Mumm and I feel that we owe him a great debt of gratitude for the trouble he took over organization both before and during the journey. The ascent of Trisul is quite easy from the technical point of view, but demands so much mechanical endurance that no one who is not in perfect health can hope to achieve it.

On June 15 Bruce and Mumm started back across the Rishi valley with the guides and Gurkhas, all carrying double loads. On the 14th I went off with Kulbahadur and Pahal Sing in an endeavour to force our way right up the Rishi valley to the foot of Nanda Devi, taking four days' food with us. With considerable difficulty we reached the junction of the Arhamani torrent with the Rishi Ganga, where we crossed the latter to the north bank by a snow-bridge (11,790 feet), as we could get no further along the south bank, and the current was too strong for wading. Here we camped under an overhanging rock amongst the birch trees. Next morning we climbed straight up to about 13,500 feet, and in the intervening 1700 feet of cliffs between this and the Rishi Ganga saw no practicable route up the valley, though we obtained a most wonderful view of Nanda Devi. I think that we were just beyond Graham's furthest point in this direction. We could see no sign of a glacier filling the head of the Rishi valley, such as is shown on the G.T.S. maps, and Damar Sing reported from his observations from the ridge which forms the eastern boundary of the Trisuli Nala, that the glaciers from the north and south of Nanda Devi do not join each other at the western base of that peak.

A. L. Mumm, Photo.

THE DHAOLI RIVER ABOVE MALARI.

Crossing back to the south bank we returned down the Rishi valley and rejoined the others at Duti on the evening of the 15th. On June 16 we all pushed on to Dibrugheta, where we were relieved of our loads by the coolies, who came in on the following day and carried them up to Durashi. On June 18 we reached our base camp in the Dhaoli valley at Surai Thota.

Our next objective was Kamet, so we had to move our base camp up the Dhaoli valley towards Niti. The encamping ground named Juma Gwar is undoubtedly situated on the old moraine of the Juma glacier, and there are several erratic boulders stranded on the hillsides to the west. Between Juma Gwar and the village of Malari the track is generally carried several hundreds of feet above the Dhaoli river, through a magnificent gorge, and skirts several stretches of water-worn rock cut into great concave cups and hollows, still quite regular and smooth: in one place the path crosses an open-sided pot-hole about 400 or 500 feet above the present level of the river. All these contours have been cut by water flowing in the same direction as the present stream, and not by lateral tributary torrents. It is obvious, then, that the river has either greatly deepened its bed, or that its erosive action has kept pace with the uplift of that bed. From the size of these water markings, I concluded that the river must formerly have carried a greater volume of water than it does now. They occur on a section of the river only 30 miles below its present source, and just on that section which pierces the main axis of elevation. Similar phenomena are of frequent occurrence in the valleys of many southward-flowing Himalayan rivers, and have been explained as due to increased erosion, cutting back, and capture, consequent on the copious rainfall and steeper slopes of the southern side. But it is just the area drained by the last 30 miles of the Dhaoli which has a much smaller rainfall than the rest of Garhwal. In this instance we seem to find support for the theory propounded by Medlicott, of an earlier drainage system which has continued to drain an area originally to the north of the main axis of elevation. Is it impossible to modify both these theories and to suggest that before the Himalayan barrier reached its present proportions, the rainfall above Malari and Niti was greater than it is now, thus enabling a larger river than exists at present to cut down and so keep pace with the uplift of its bed? From what I saw in the neighbouring parts of Tibet two years ago, I am quite convinced that the rainfall there was formerly much greater than at present.

At Malari, 10,011 feet G.T.S., an important Bhotia * summer village, we are opposite the mouth of the Girthi valley; the country to the north and east is beginning to assume a Tibetan character, the skies are

* For an account of these very interesting people, *vide* C. A. Sherring's paper in *Mems. As. Soc. Bengal*, 1, p. 8.

bluer and the mountains barer, both of vegetation and snow, though there are some very fine deodars close to the village. Here I was greeted by a Bhotia whom I had met two years previously at Shibchilam, in Hundes. I had there engaged yaks from the Dzongpön of Daba to take my belongings back into India. To my surprise, the Tibetan in charge bolted in the night with the yaks at the foot of the Chor Hoti pass, after having taken me all through the Dakka hills and over the Shalshal pass into British territory. I had no difficulty in reaching Niti, but, as a matter of form, wrote a note in English complaining to the Dzongpön. Months afterwards I had received a postal order for Rs.8 for which I could never account. Now the Bhotia informed me that the Dzongpön had sent this sum to me as the balance due from the full yak hire I had already paid, and which had been forfeited owing to the flight of the Tibetan driver. This is a striking example, not only of Tibetan honesty, but of the friendliness with which English people are regarded by Tibetan officials. Doubtless the epidemic of political aloofness which is at present so popular in this country will lose for us the good impression that we have made, for the position which we have taken up over the Tibetan question will inevitably be attributed to fear.

From Malari we sent our baggage up the valley through Gamsali village to Timor Shim, the encamping ground below the large Bhotia village of Niti, 11,857 feet, while we crossed the easy Kurkuti Dhar, 15,064 feet, getting fine views of the Hoti peaks and up the Gamsali glen. The descent to camp of about 3500 feet was very easily accomplished in an hour, thanks to several glissades, for we were entering a country of gentler contours and of very different conformation to the ranges which form the main axis of elevation.

At last we were able to persuade Karbir to pay some attention to his frost-bitten foot, from which he was now suffering acute pain. Leaving him in charge of the base camp at Timor Shim, we started again along the Niti track with eighteen *jhobus* and fourteen coolies. The Dhaoli valley above Niti is of considerable geological interest, for the river follows the course of the great fault between the crystalline rocks of the main axis (Nanda Devi, Trisul, Dunagiri, and Kamet range) and the younger sedimentary beds which are developed along the Tibetan frontier. On the gneiss of the right bank are the last outlying pines; on the left there is only scrub, with the last rhododendron and birch trees at Goting E.G. (12,490 feet) where we camped on June 26. The view up the valley and the actual surroundings at this spot are strikingly reminiscent of the analogous solitudes across the Tibetan frontier. The *bharhal*, the marmot (*A. Himalayanus*), the red-billed chough (*G. eremita*), and the snow-pigeon (*C. leuconota*) seem to be the chief permanent inhabitants. The very air is now much drier and clearer and the sun more powerful, and we could daily watch the white clouds roll up from the south-west only to dissolve above our heads. On

June 27 we crossed the Dhaoli by a natural bridge. Above this the valley was remarkable by reason of the triple tier of gravel beaches raised one above the other on the left bank of the river. On turning up the Raikana Nala which still follows the course of the great fault to which I have alluded, we deserted the track to the Niti pass. But it was interesting to note that the Raikana river possessed a greater volume of water than the Dhaoli, although the latter has received the waters of the Ganes Ganga. In this region the rainfall diminishes with every step towards the north.

On June 27 we made our first camp in the Raikana Nala, at a place called Kali Kharak (13,600 feet). We were on the left bank of the Raikana river, which has here cut a deep gorge for itself through moraine stuff along the line of the great fault. Up the valley to the north-west is a huge moraine, marked on the G.T.S. as a series of hills. It is, however, a true terminal moraine, the greater part of which is still lying on ice which certainly descends below 15,000 feet. Immediately at its foot is an irregular plain, scattered over with huge moraine blocks and supporting a scanty growth of juniper and grass: this is called Raikana Kharak (14,200 feet), and is occasionally used as a pasturage for yaks and *jhobus* by the Niti Bhotias. Here I saw a rare and beautiful little bird, *Erythacus pectoralis*, a near relative of the Arctic "bluethroat." Crossing this, the next morning we ascended the moraine, but, owing to the badness of the going, had to stop at 11 a.m. and send the *jhobus* back to their scanty pastures at Raikana Kharak. Our camp was pitched at 15,350 feet, on a level patch of moraine-stuff adjoining the ice on the left bank of the glacier, and directly below Chango, 20,216 feet. We were able to obtain wood from the juniper bushes at Raikana Kharak.

On June 29 I proceeded up the left bank of the main Raikana glacier with the two Brocherels. We passed several fine glacial pools, which might almost be accorded the title of *marjelen* lakes, the larger ones containing small floating bergs. In three hours we reached a height of about 16,300 feet, the glacier being very rough and crevassed. To the north-north-west was a snow-pass leading into Tibet, and on this side easy of access. To the west we were looking straight up a glacier, which leads to what I take to be Strachey's 24,670-feet peak, about a mile to the north-east of Kamet itself, and which I had seen from Gurla Mandhata, 100 miles to the east in 1905. Owing to inaccuracies in the map, we had overshot our mark, which was the glacier leading to Kamet itself. After watching some *bharhal* feeding on the stony slopes opposite at over 16,000 feet, we turned back crossing over to the right bank of the glacier, and skirting round a great buttress so as to reach the glacier which flows from the actual south-east base of Kamet, and which, for convenience, I shall call the Kamet glacier. We had to climb high above some bad cliffs on the buttress, but eventually dropped down on

to the Kamet glacier and continued up it to a height of about 16,300 feet. Here we saw enough to show us that we were on the only possible route by which our peak could be attacked on this side, though we could not reconcile the map with what we saw before us. Descending the Kamet glacier, we found that it united with the Raikana glacier, its extremely broken and moraine-covered surface having doubtless deceived the surveyors into thinking that the two ice-streams did not join one another. We reached our camp late in the evening, after a very long and fatiguing day.

On June 30 we started to reconnoitre Kamet, taking with us the two Brocherels, six Gurkhas, and ten coolies. Crossing the Raikana glacier, we went up the Kamet glacier, and, after some rough walking, made a camp at 16,800 feet on the left lateral moraine, where we found some big boulders on a grassy slope, which gave our camp a very luxurious air. As usual, we sent the coolies back at once. On July 1 we did not start till 6.30 a.m.; to follow the glacier further would have been very risky, owing to the dangerous hanging glaciers which drape the northern slopes of Mana peak (No. 1, 23,862 feet, G.T.S.), so we turned sharply to the north-west up a very steep moraine-slope. This landed us on a glacier of the secondary order which flows down a typical hanging valley. Our surroundings gave a striking example of the conservative effects of ice. The small glacier stream emerged from the snout of the glacier at an altitude of about 17,400 feet. The ice-covering was obviously checking the development of the valley, in particular, inhibiting the back cutting by the stream, which, as I have remarked, is but a small one, for the higher the ice the less is the melting.

Heavy clouds were blowing over the ridge from the south-west, but the echo from the cliffs on our right kept us straight. We pushed on over ever steepening snow-slopes, and at 1.30 p.m. reached the crest of the ridge. The Watkin observation gives a height of 20,180 feet, worked out in the way I have indicated in the notes. But the camp was fixed, as usual, by hypsometer, and using this as a lower station, the reading would be 20,870 feet. I think this tends to show that the other altitudes are not overestimated. The clouds cleared somewhat, and we saw directly below us the avalanche-swept Kamet glacier winding down from the foot of that great peak (25,443 feet G.T.S.). But we were completely cut off from it. Worse still, we never got a complete view of its stupendous south-east face, which falls in a succession of red precipices more than 7000 feet to the glacier below. We had carried the plane-table up with us, but with all the clouds about it was useless to set it up; indeed, the cold wind alone was sufficient to drive us down after we had waited for three-quarters of an hour in hopes of a clear view. We had seen enough to know that there was no practicable route by which the peak might be attacked on this (eastern) side. The

upper Kamet glacier is horribly dangerous, lying in so narrow a gorge that it would be quite impossible to escape from the ice avalanches which constantly fall on to it. During the descent we again noticed how the clouds were dissipated as the dry air of Tibet was approached, and over the Chango ridge we obtained the most wondrous glimpses of that part of Tibet in which it had been my good fortune to wander two years previously.

Next day we returned down the Kamet glacier and crossed the Raikana glacier to our camp. One of the largest of the glacier lakes had emptied itself since we had passed it three days earlier.

As we considered it useless to attempt Kamet from the east, we now decided to cross the main range to Badrinath, in the valley of the Alaknanda. Our heavy baggage would have to go round by Joshimath, but by using a snow pass known to the natives, we hoped to be able to cross with sufficient tents and supplies to keep us till our heavy camp could arrive. So we all returned to Niti, and on July 4 had the whole of our effects carried down through the wonderful Niti gorge to the encamping ground (11,190 feet) opposite the village of Gamsali, on the right bank of the Dhaoli river.

On piercing the narrow gorge below Niti, where it bends upon itself at an angle of 45°, the Dhaoli cuts its way deeply through a vast bed of hard silicious mud and great angular boulders, which extends for 3 or 4 miles down the valley towards Malari, and forms a more or less level floor, about 2 miles wide at its broadest, between the steep gneiss cliffs which bound the valley on the east and west. I cannot escape the conclusion that, though portions of this bed may be due to rock-falls from above, a considerable part of it represents a moraine left by the recession of the huge glacier system which still fills the head of the Gamsali glen. But I feel still more certain that no glacier ever pushed through the Niti gorge from above, though there are water-marks there high above the present level of the stream, showing how it has deepened its bed.

On July 7 we started up the Gamsali valley with about twenty Bhotia coolies, and soon found ourselves amongst a chaos of huge rocks. These are probably the result of rock-falls overlaying moraine stuff. The valley is shut in on either side by the most glorious gneiss cliffs, the general effect produced being similar to that of the Vale of Lauterbrunnen carved on a sublime scale, but with the forests absent. Further on we came to an unmistakable terminal moraine, its summit raised above the valley floor immediately ahead. At this time of year it was a veritable garden of flowers, and afforded excellent pasturage for the Gamsali flocks. It can only have been formed at a time when the snout of its parent glacier was almost stationary, or only retreating very, very slowly. After this the glacier must have retreated with great rapidity back to its present point of termination (13,000 feet),

about which it has made another stand, as evidenced by the formation and character of its moraines. The intermediate distance is a flat waste of stones, through which the stream wanders in many channels, but the lateral moraines are still well marked where side streams and avalanches have not destroyed them. The secondary glaciers, coming down from the G.T.S. peak, 19,815 feet, formerly joined the main glacier, and even now come down very much lower than is indicated on the maps. From the largest a stream of stone avalanches falls, both day and night, over a steep cliff on to the moraine of the main (Baṅke) glacier below. This is an example of how the *recession* of a glacier might in particular circumstances close a route, for at the time when this secondary glacier joined the main ice-stream such rock-falls could not occur. Though I have not visited the Ralam pass myself, I believe, from what I have heard from natives, that this is the probable explanation of the closing of that old route from Johar into Darma.

We camped on July 7 at a spot called Thur Udiar (13,000 feet), close to the snout of the main glacier, to which the Gamsali people gave the name of Baṅke *gal*. Next day we followed the left lateral moraine for two and a half hours, and camped on a flat shelf behind it called Eri Udiar (Cold Cave) (14,690 feet). Here were the last of the juniper bushes; the fact that they had not all been cut for fuel long ago in itself showing how rarely the natives visit this spot. Facing us was a magnificent ice-fall, flowing down the slopes of G.T.S. peak, 21,198 feet, in a north-easterly direction, while from the steep slopes above our camp there was a splendid view of Rataban, 20,094 feet, and also of the beautiful little glacier lake at the foot of the former peak. The pass by which we meant to cross the range lay between these two fine mountains, but was completely hidden behind a subsidiary spur of the 21,198-feet peak. It was crossed in 1862 by Colonel Edmund Smyth,* and we were told later by the priests at Badrinath that one of the Stracheys had also crossed it.

I returned for letters to Gamsali with Bruce, who had to make arrangements for sending Karbir round by the valley route with our heavy camp. On the 9th and 10th, in spite of very unsettled weather, Mumm and Inderbinen explored the upper Baṅke glacier towards the Mana peak (G.T.S., No. 1, 23,862 feet), finding most unexpected indications of a pass. I regret we did not follow this up by attempting to get to Mana by this new route. On July 11 we all assembled once more at Eri Udiar, and started at 7 a.m. next morning to cross the Bhyundar Khanta, taking about twenty lightly laden coolies with us. We reached the top of the pass without difficulty at noon, and saw three *bharhal* above us. I found the altitude to be only 16,700 feet. The view to the

* *Vide* MacIntyre's 'Hindu-Koh,' p. 384.

RATABAN (20,094 ft.) FROM THE SLOPES ABOVE ERI UDIAR.

A. L. Mumm, Photo.

south-west into the green Bhyundar valley was very fine, and a great contrast to the stony desolation of the north. Due south rose Gauri Parbat, 21,747 feet, well named the "Brilliant peak," and over its shoulder we could see the top of Hathi Parbat, 22,141 feet, named after its resemblance to the body of a reclining elephant. We were standing upon more than a mere water-parting, for this is the screen which precipitates so much of the rain borne by the south-west monsoon, and accounts for the higher snow-line (17,000 to 18,000 feet) found to the north and east, and for the very different flora and fauna which are found on that side. The same state of things prevails on the north and south sides respectively of the Nanda Devi group: on the south the snow-line is about 16,000 feet, the glaciers descend to 12,000 feet, and the forests are very extensive; while on the north the forests are scanty or absent, and end well below the terminations of the glaciers, which, though frequently greater in volume, do not descend so low (13,000 to 14,000 feet); but, owing to its complicated orography, there is no spot comparable to the Bhyundar Khanta, where the two different landscapes are brought into the same immediate field of view.

Though the snow-slopes on the north are much crevassed, and those on the south are steep and require some care, this pass is not at all difficult as compared with the Alpine standard. The G.T.S. is inaccurate on both sides, but especially on the south, where the number and extent of the glaciers is greatly underrated, one of those left out being some 6 miles in length. Still, the map was of the greatest use to us, and would enable a mountaineer to plan routes with considerable confidence.

The descent is broken by a cirque of cliffs over which the ice of the G.T.S. Thiapap-ka-bank (Garhwali Bhyundar) glacier tumbles, but we avoided them by a long traverse to the west on steep snow, and, scrambling down a rock gully, reached the dry glacier itself. Gradually we edged off the glacier towards its high right lateral moraine. We now saw the full face of Hathi Parbat, from the western base of which a large glacier rises. At its head is a pass, practicable on this side at least, which, according to the G.T.S., would lead over on to the Juma glacier. It joins the Thiapap-ka-bank (Bhyundar) glacier about a mile below what is shown as its termination on the G.T.S. Opposite this junction we camped, at 3.30 p.m. There is plenty of juniper and good shelter amongst the boulders, with water not far off, and the place is known as Shem Kharak (12,800 feet). We did not see the lake marked as Lakpal-ka-kund on the G.T.S.

We continued down the moraine next morning (July 13) for three-quarters of an hour, when we reached the snout of the Bhyundar glacier at an altitude of 12,000 feet. Our route now lay across the most luxuriant meadows I have met with in this part of the Himalaya. We waded through flowers up to our waists—ferns, yellow lilies and anemones, green fritillaries, purple monkshood, and in the drier spots a

beautiful blue dwarf iris, and white and red wild strawberries, with forget-me-nots and large yellow king-cups by the streams. Swallow-tailed butterflies and small birds were flitting about us on all sides. Altogether we found its charm so irresistible that we camped at 10.30 a.m. This spot was called Bhamini Daur by our coolies. It is situated at an altitude of 11,650 feet, just where the Bhyundar river, which has been flowing in a south-westerly direction, makes a sudden sharp turn to the south into the jaws of an extraordinarily abrupt defile. We were told, probably incorrectly, that this defile is quite impassable lower down. A fortnight later we passed the spot where it enters the Vishnu (Alaknanda) river, a mile below Pandukeswar.

We left this camp at 8 a.m. on July 14, going due west towards an obvious pass. After scrambling up a very steep grass slope beside a fine waterfall, we emerged into a hanging valley strewed with moraine heaps, and into the upper (north-west) part of which a small glacier descends. Passing below its snout, up easy grass slopes, we reached the pass known as the Khanta Khal at 11 a.m. The hypsometer gave the altitude as 14,750 feet and the corrected Watkin aneroid as 14,500 feet. I obtained a fine five-plate panorama of the peaks and glaciers to the north and east, which has been utilized for our map. To the west clouds somewhat interfered with the view, but the wonderful snowy spike of Nalikhanta, 21,713 feet, dominating Badrinath, stood out glittering above them. We descended through a wild glen to Hanuman Chatti (8500 feet), the descent of 6000 feet in 2½ miles being accomplished in less than three hours. The beds of avalanche snow in the nala extended almost down to the village, and we had some splendid *glissades* whenever we could get down into it.

At Hanuman Chatti we were on the great pilgrim route to Badrinath, which we passed through on July 15, pitching our camp at Mana village the same day. While waiting for Karbir and our heavy camp to come up, Mumm visited the junction of Bhagat Kharak, and Satopanth glaciers from which the sacred Alaknanda river issues, while I pushed on up to Mana pass, and reconnoitred the western approaches to Kamet. I suggest that the name Sarasutti, given to the main river above Mana by the G.T.S., is really Saraswati, a name of great historical interest and of very ancient origin.

Just as the Garbyang Bhotias trade with Purang (Taklakhot) over the Lipu Lekh, the Milam Bhotias with Gyanema over the Untadhura, and the Niti Bhotias with Daba over the Niti pass, so do the Mana Bhotias carry on the trade with Tsaprang and Toling (Totlingmath) over the Mana or Chirbattia pass. The gradients are easy, but the going is extremely bad for yaks, ponies, or sheep, all of which are used for transport. The upper half of the route lies over a chaos of unstable rocks of all shapes and sizes. The distance from the highest village, Mana, to the pass is 25 miles. This can be done by men in four days,

but pack-sheep take at least a week. The chief encamping grounds are—

	Hypsometer.	Corrected Watkin aneroid.	G.T.S.
Ghastoli	13,200	13,100	—
Balbala	15,500	15,250	—
Rata Kona	15,950	—	16,003*b*
Jagrau	17,550	17,150	—
Mana pass	—	18,088	17,890*b*

On July 18 I made a short reconnaissance towards Kamet. Leaving Ghastoli E. G. at 6.45 a.m., we proceeded up the valley past Khaiam E. G. for an hour and a half, and then turned east up into a hanging valley over a steep moraine-strewn slope. The ice of what might fitly be named the Khaiam glacier descends to 15,400 feet. Ascending this glacier for some little distance, we struck up on to the ridge to the south, at 2 p.m. reaching the summit of one of its peaks at an altitude of 17,550 feet. To the west was the Bidum glacier, and to east-north-east Kamet itself. The Khaiam glacier probably forms the most practicable route to the attack of this peak. To the south was the Ghastoli peak, marked as 18,002 feet on the G.T.S. We certainly seemed to be higher, and I think the altitude is wrongly marked. We had a very good climb down the rocks on the reverse side of the ridge to the glacier which enters the Mana valley just above Ghastoli, and to which I would attach that name. The ice descends to about 15,000 feet.

No European seems to have visited the Mana pass since the visit of the surveyor, Mr. I. S. Pocock, in 1874, during which visit, as I have already mentioned, he reached the great altitude of 22,040 feet. The survey appeared to me to have been exceedingly well done.

Game is extremely scarce, though grass and flowers are to be found at great altitudes. On the pass itself, at 18,000 feet, I found *Primula minutissima*, *Parrya lanuginosa*, and a *draba*,* all in flower. The gneiss and crystalline schists extend up to the water-parting, but the landscape on the Tibetan side suggests a later formation. The Abijugan glacier appeared at the time of my visit to lie exactly across the pass, and to discharge streams both towards the Sutlej and the Alaknanda.

From the number and extent of the glaciers on this part of the Tibetan frontier, I concluded that the rainfall must be considerable, and certainly greater than it is further east.

During the whole of the week I spent in the upper Mana valley I felt the effects of the high altitude severely, though the mythical symptoms (hæmorrhages, etc.) of that dread disease, mountain sickness,

* For these identifications I have to thank Mr. Edmund Baker, of the British Museum.

were absent. The guides and Gurkhas showed no weakening of their powers, though we had a hard time. We experienced very bad weather, with high winds and frequent snowstorms, and our doings were finally cut short by the breaking of the rains on July 23. So abandoning all hope of further ascents, the whole party descended to Joshimath, and on July 30 recrossed the Kuari pass.

Next day Bruce and Mumm left for Kashmir, taking the guides down with them, while I went off on a long-cherished scheme to visit the valleys to the west of Trisul, and that of the Sukeram glacier to the south-east. By this means I hoped to link up the knowledge I had gained in 1905 with that of last year, and thus to be in possession of a fairly comprehensive view of the orography of the Nanda Devi group.

Of the Peri-Sutol valleys I have nothing new to add, nor any fault to find with the maps. I found that the G.T.S. peak, 21,286 feet, was universally known to the local people as Nanda Ghunti. The two terminal nalas of Silla Samudhar and Ghingtoli have been very rarely visited by Europeans, and would well repay further study.

In the latter part of August I visited Sunderdunga. This is more correctly written Sonadhunga, which means the "Golden Rock;" it is celebrated for the gold which used to be obtained by washing the river gravel there, and also for the number and malignancy of the local demons, who are particularly averse to the human voice. As the result of five observations, I obtained 10,636 feet as the altitude of the shepherds' huts, which agrees very well with the barometrical value, 10,620 feet, of the G.T.S. The place is approached by a very bad jungle track up the valley of the Sunderdunga (or Sonadhunga) river, the distance from the hamlet of Jatholi, though only 6 miles, taking six hours to cover.

On August 24 I visited the Maiktoli glacier, which descends from between the peaks A_{29}, 22,360 feet (sometimes known as East Trisul), and A_{28}, 21,858 feet, to a height of about 12,500 feet, according to the G.T.S. In the black gorge which leads from Sona-dhunga to this glacier is a permanent snow-bed, the walls of the gorge being so narrow that the sun can never penetrate its recesses sufficiently to melt it. It is formed by avalanches of winter snow, and on careful examination reveals most of the usual glacier phenomena, such as crevasses, lateral moraines, and ice-tables, all of course on a minute scale. This snow-bed is indicated on the map. Its altitude is between 500 and 1000 feet above Sona-dhunga, which would make it about 11,000 to 11,500 feet above sea-level.

On August 25 I started up the Sukeram Nala, and camped for four nights at the shepherd's cave, known as Sukeram Udiar, 12,570 feet. At this spot a beautiful blue poppy (sp. *meconopsis*) was very abundant. I had the plane-table with me, but the rains were not yet over, and unsettled weather prevented me from doing as much as I had hoped.

However, on August 28 I reached the great southerly bend of the Sukeram glacier, and mounting to the summit of the left lateral moraine, which is of a very unusual type, I had a fairly good view of the upper part of the glacier from a height of 15,500 feet. In place of the ridge shown on the G.T.S., between the peaks A_{20}, 22,360 feet and 20,010 feet, forming a water-parting between the Kurumtoli and Sukeram glaciers, I saw that these two peaks were entirely separated by the Sukeram glacier, which rises from the south-western flanks of the G.T.S. peak A_{20}, 22,360 feet, and the southern slopes of A_{20}, 22,490 feet, and is constantly fed by avalanches from the former peak. The massif centring in the G.T.S. peak, 20,010 feet, which the Danpurias of the upper Pindar valley call Simmu Saga, is entirely cut off from the East Trisul ridge, forming a southern outlying group of its own. Chakuri Jhaba was given me as the name of the second peak, 18,517 feet. This group sends down three glaciers towards the Sukeram, two of which unite with the main ice-stream. I have already pointed out * that the glacier shown by the G.T.S. as joining the Kurumtoli glacier on its eastern side does not in fact do so. It represents the head of the Sukeram glacier itself, which lies on a great shelf tilted up towards the west. The snout descends to 13,200 feet, and shows signs of recent recession. On the lower part of the glacier I shot a *bharhal*. It was interesting to find that the local *shikari* did not recognize it, but called it a *thar* (*Hemitragus jemlaicus*), of which there are large numbers about here. He was very loth to accompany me at all, and had it not been for the presence of the two Gurkhas, would probably have run away from this demon-haunted glen. It appears certain that no European or native had previously visited the glacier itself, and I failed to find any sportsman who had ever heard of *bharhal* in this locality. It offers a very favourable field for the mountaineer who is not merely actuated by the desire to break records.

I hope that it is evident from what I have written that my criticisms on the work of the G.T.S. are made in no captious spirit. The triangulation of the main features of the country is well known to be extremely accurate, and considering all the circumstances under which the survey was made, the errors in the topographical details are surprisingly few in number, and of no importance from a political, strategical, or economical point of view.

Notes.

In the foregoing paper the words "right" and "left" are used in their true orographical sense, unless it is directly stated otherwise in the context.

The map which accompanies this paper is based upon the fixed points

* *Geographical Journal*, vol. 39, p. 210.

of the G.T.S. of 1 inch to 1 mile. The topography of the Rishi and Bagini valleys is from a plane-table survey on the scale of 1 inch to 2 miles, carried out by Havildar Damar Sing Rana, 5th Gurkha Rifles, with a little help from myself. A few portions of this area, to which he did not penetrate, and the rest of the ground covered by us, are drawn from corrections to the G.T.S. made on the spot by myself, and from photographs taken on various occasions by Mr. A. L. Mumm and myself.

The altitudes have been taken with two hypsometers and two (4½ and 3 inch) Watkin mountain aneroids. I am immensely indebted to Dr. Gilbert T. Walker, F.R.S., Director-General of Observatories, Meteorological Department of India, who has most kindly had thirty-two hypsometer and ninety-seven Watkin aneroid observations worked out for me. Each observation has been worked out separately, although they only deal with some sixty places. The meteorological observatory at Muktesar, 7500 feet, close to Almora, has been taken as the lower station. From May to September the maximum variation of the daily mean was only 0·35 inch. The Smithsonian tables have been used throughout, in preference to Airy's tables, which would give higher values. I am, however, entirely responsible for the final results as given in this paper.

The great majority of our camps have been fixed by one, two, or three hypsometer readings, but to obviate any overestimation, 200 feet has been subtracted from each result. Mr. Reeves assures me that this is a more than sufficient allowance for the probable error. At the same places sometimes as many as seven observations were taken with the Watkin aneroids. Combining these results with about half a dozen G.T.S. values, I have a very good series of control observations for the Watkin aneroids, from which the rest of the altitudes, and the differences in altitude mentioned in the text, are obtained. Both aneroids invariably but consistently underestimated the height, doubtless due to the fact that owing to our great mean elevation during five months they had to be kept constantly closed (*i.e.* out of action), and that I never gave them more than half a minute to "settle." This error has been averaged and allowed for, but all odd feet have been cut off, so that the results are given throughout in round figures, as I do not believe that any barometric or hypsometric method of determination can be absolutely relied upon in a mountainous country. Most of the altitudes determined by me are given in brackets. In the case of the level to which the various glaciers are stated to descend, it must be remembered that, owing to the accumulation of moraine stuff at the snout, it is often impossible to tell exactly how far the ice itself actually extends. As a rule the G.T.S mistakes heavily morained ice for *terra firma*.

I am indebted to Prof. E. J. Garwood for naming some geological specimens, for the loan of a plane-table, and for much valuable advice before I left England.

Before the paper, the CHAIRMAN (Mr. Freshfield, Vice-President) said: The paper to be read to-night is on explorations in the Himalaya. Since it is only two months ago that we had a very interesting paper from Dr. Workman on his explorations in the Himalaya, it may seem to you somewhat soon to return to the same region. But I may point out, I will not say excuses, but reasons why we should find ourselves paying more frequent attention to the mountainous portions of the globe. As exploration goes on, the level, or comparatively level, regions are naturally the soonest exhausted, and adventurers turn to the unexplored regions, either to the snows of the Poles or the snows of the Peaks. There is another reason which I might allege: that the Himalaya is a term which covers an exceedingly wide tract of country. I would not impute to any Fellow present any lack of intimate knowledge of the Himalaya, but I cannot but recollect that in this hall I was asked, when I went to Kangchenjunga a few years ago, whether I had been treading in the track of Sir Martin Conway. Now, the distance between Kangchenjunga and the scene of Sir Martin Conway's travels is equivalent to that between the Gross Glockner in Carinthia and Mont Perdu in the heart of the Pyrenees. Therefore, though we may be talking about the Himalaya, we are not talking about the same region. Dr. Longstaff's paper is a description of a district in the centre of the Himalaya, roughly speaking, north of Agra. If you look for it in your atlases, you will find it just to the west of that long green caterpillar that crawls along the back of India, the native state of Nepal.

With regard to the author of the paper, he does not require any introduction to this audience. He must be doubly welcome, first as the son of a father who, when His Majesty's late Government found themselves inadequate to support the great Antarctic Expedition, made it a possibility, and secondly, because we already know Dr. Longstaff here. He published a paper in the *Geographical Journal* of February, 1907, on his previous Himalayan journey in company with Mr. Sherring. The present expedition is, I should remind you, the result of the proposal, the unfortunately unsuccessful proposal, that was made to His Majesty's present Government, that an expedition should be sent, at no cost to the nation, but entirely at the cost of those who were undertaking it, to explore the neighbourhood of Mount Everest, and to ascertain the accessibility of the highest mountain in the world. When the present Cabinet refused leave to that expedition, the members of the Alpine Club who were prepared to undertake it diverted their thoughts to something of a more modest kind, and set out on the journey of which I will now call upon Dr. Longstaff to give you an account.

After the paper, Mr. FRESHFIELD said: I have listened with very great pleasure to the graphic description which Dr. Longstaff has given us of an Himalayan district, one of the most graphic descriptions we have ever had in this Society. I am sure we have all followed his adventures with the keenest interest, and that I am only interpreting the sentiments of every one here present in saying that we have thoroughly enjoyed his lecture and the most beautiful series of photographs which he has put before us to-night. My only regret is that since we are preeminently an Early Closing Association, Dr. Longstaff has been unable to give us the solid results of his journey, the mass of observations, geographical and topographical, which he and his companions have made. However, I remember what Sir Roderick Murchison said to me forty years ago, when I first read a paper before the Society. "Tell them your adventures, and print your results." And fortunately we shall have the advantage of reading in an early number of the *Journal* the full results of this remarkable expedition. Dr. Longstaff and his companions have done a very solid piece of work, and they have been fortunate in crowning it by an exploit, which may perhaps be more appreciated at the Alpine

Club than it is here, the conquest of Trisul. That mountain has two advantages: in the first place, it has been triangulated, and therefore there can be no dispute as to its height; and, in the second place, it is one of the historical, perhaps I should rather say one of the legendary, peaks of India, one of those great pinnacles of everlasting snow which look down upon the heated inhabitants of the plains, and are associated by them with the Abode of Deity. I am sure I shall also interpret the sense of this meeting, if I express our keen sympathy with Dr. Longstaff's companions, Major Bruce, who has done more, perhaps, than any man for Himalayan exploration by his training of the Gurkhas, and also with Mr. Mumm, for the unfortunate, though happily temporary accidents, which prevented them both from taking part in that crowning mercy, the ascent of Trisul.

Dr. Longstaff has, like all Himalayan travellers, had to suggest corrections in the topographical detail of Survey maps. I have said *Himalayan* travellers, but I might have dropped the adjective, for all mountaineers have to do the same thing. If Napoleon the Great was the founder of European cartography in the political sense, General Dufour was the founder of scientific mountain cartography. The Swiss Survey is the only one in which extensive alterations have not had to be made since the snows came to be explored by mountaineers. Twenty-five years ago, when mountaineers first went to India, they no doubt, some of them, expressed their criticisms crudely. They were misunderstood, and a certain amount of antagonism was excited between surveyors and climbers. All that has happily long passed away, and, if they sometimes criticize, there are no people in the world so well able to appreciate the merits of the Indian maps and the difficulties under which they were constructed as those who wander among the hitherto inaccessible recesses of the mountains. One of the first-fruits of the cordial understanding that now exists is the fact I mentioned here some months ago, that the Geological Survey of India are undertaking a series of measurements of the movements of glaciers, such as were first instituted by the Alpine Club in Europe. There is a further suggestion I should like to make—that the idea of starting in India an Himalayan Club, first suggested by the Kashmir surveyor, Mr. Johnson, should be followed up. Such a body might do a great deal, by collecting observations and by publishing a journal, to assist mountaineers; it might study the question of reaching the highest altitudes. I have several suggestions that I might make as to how any attempt should be made to reach 29,000 feet, but I see among the audience my friend Mr. Woolley, President of the Alpine Club, and I will leave that branch of the subject to him.

I notice that at the last meeting, when we discussed the Himalaya, Dr. Longstaff referred, as he has again to-night, to Mr. Graham's ascents. These ascents were made too early. Twenty-five years ago they were ridiculed in India, and they are still disbelieved by many people, whose opinion is worthy of consideration, in this country. This was to a great extent Mr. Graham's own fault. He described his travels without any of the precision in detail which is expected of the modern explorer. But as I was mainly responsible for bringing them before the attention of this Society, I must confess to having felt a certain satisfaction in finding that the two main grounds upon which they have been disputed have fallen through. One ground was that it was impossible to climb above 20,000 feet at the pace at which Mr. Graham said he climbed. Dr. Longstaff has climbed faster at the same altitude. The second was, that Kabru was an inaccessible mountain. Now, on October 20 last two Norwegians climbed to the summit ridge of Kabru. With regard to these two plucky Norwegians, I would add a few words. They reached the summit ridge of Kabru between the two peaks, but did not go to either top. They started too late, and they had much step-cutting, and

time prevented them. They climbed apparently to 23,800 or 23,900 feet. But do not fear that I am going to trouble you with any discussion about records. I was born before records were invented, and if an old mountaineer may give advice to his younger friends, I would strongly recommend them to follow Dr. Longstaff's example—not to insist too much on records, to think more of getting to the tops of their peaks, and less of getting higher than their rivals. For a record in mountaineering is, after all, a very fleeting possession, a very transitory joy. The spirit of the Alpine Club has never been, if I may say so, one of self-advertisement or of jealousy; it has rather been one which might be expressed in the words (slightly altered) of a living poet, the Poet Laureate of the English race, Mr. Rudyard Kipling—

> "And no one shall *climb* for money, and no one shall *climb* for fame,
> But each for the joy of the *climbing*."

And I would add, for the memory of it in after-years.

I will now ask Dr. Longstaff's companion, Mr. Mumm, to address us.

Mr. Mumm: There are two things I wish to say to persons about to go mountaineering in Garhwal: first, they should take the precaution of being somewhere between twenty-eight and thirty-five years of age, and, secondly, they should concentrate, and not try to cover too much ground. It was largely due to my neglect of the first of these points that I did so little climbing in the first part of my journey; it was disregard of the second which led to none of us doing very much in the second stage of it. Of course, in a new country which one is not likely to return to, it is very tempting to try to see as much of it as possible, and I am not sure that I did not get as much pleasure from our actual wanderings as I should have done if we had wandered less and climbed more. But you cannot have it both ways. In the Alps you can have it both ways. You can go over glacier passes or traverse the tops of peaks, and need never sleep two nights in the same hotel. But when you have got to carry your hotel about with you, it is a different matter. There is a magnificent field in Garhwal for mountain travel of both kinds. For the wanderer there are the great glaciers, all abounding in superb scenery, and many still wholly unknown and full of surprises. They are most of them very accessible; indeed, their moraines are almost the only places in Garhwal along which you get a decent place to walk. As for the climbing possibilities, they are simply limitless; but if you want to climb, you must, as I said, concentrate, and you must not yield too much to the spell of the great giants. I think Kamet was to our party rather a will o' the wisp. Our Italian guides, the Brocherels, were always pining to go to the top of something: they didn't trouble themselves as to whether it was 23,000 or 21,000 feet, nor as to whether it had a name or not. Their attitude was, "Here are the mountains: they are big, they are difficult, no one has been up them; what more can anybody want?" I think this attitude is the one most likely to lead to successful climbing in the Himalaya. I should myself like nothing better than to return to Garhwal in that frame of mind, and I have a beautiful programme for my next visit. I should not go near Kamet or Nanda Devi; there would be lots of climbing, and I should only shift my camp twice, one day's march each time. I should finish up at the glacier above Gamsali, which I have a special reason for wishing to revisit. I did go up it for a considerable distance, and I had a very curious experience. It was very much as if one had started from the Furca Hotel to explore the Rhone glacier, relying on a map which showed that the upper part of the glacier was surrounded by a circle of rocky mountains, and one found instead that the glacier went down the other side and disappeared round the corner on the way to the Gadmenthal. That, of course,

is what you do find when you go up the Rhone glacier; I am not prepared to guarantee that the same thing happens with the glacier above Gamsali, but that is what it looked like. I had to shelter from a snowstorm for a long time, and when I got to the point from which this unexpected behaviour of the glacier was visible, it was too late to go any further, and so that little topographical problem had to be left unsolved. I have referred to it, partly because it is a good illustration of what I was saying about the interest attaching to glacier exploration in these regions, partly also because it is the one interesting thing that I found out all by myself. The clearing up of that problem will be the last of the agenda on my programme next time I go to Garhwal. Only I am afraid there never will be a next time.

Mr. H. WOOLLEY: I regret not to be able to make any important comment on the very interesting description to which we have listened, as I have never ascended to a greater height than 18,500 feet, and have never suffered directly from the effects of diminished atmospheric pressure, whereas I believe that the serious effects of an insufficient supply of oxygen begin, with a man in good training, at about 20,000 feet. The problem with regard to the height attainable by a pedestrian has reached a very interesting stage. Taking the highest point gained hitherto at 24,000 feet, Dr. Workman, who gave us an address here some weeks ago, seems to think that, owing to the great loss of strength and vitality due to the difficulty of respiration, the limit will be reached, even on an easy gradient, within the next 3000 or 4000 feet. Dr. Longstaff is more hopeful, and his party did not seem to be affected to anything like the same degree as Dr. Workman's party. But Dr. Longstaff will probably admit that in order to reach the higher summits—say of 26,000 feet and upwards—it will be necessary to have two parties. The first party, as lightly equipped as practicable, will complete the final ascent; the second party, also composed of experts, will accompany the first party as far as possible, and up to that point keep them supplied with necessaries, and relieve them of all labour except the actual labour of locomotion. It will be interesting if an experiment on these lines can be tried on a mountain presenting no very great climbing difficulties. Dr. Longstaff's photographs were very beautiful and instructive, and some of the most striking views were those of the gorges showing what a wonderfully effective cutting instrument a mountain torrent is. I have listened to the description this evening with the greatest interest and pleasure, and am very glad to have this opportunity of congratulating Dr. Longstaff on his notable ascent of Trisul.

Sir THOMAS HOLDICH: I have nothing but admiration to express for the energy and the ability which Dr. Longstaff has shown in conducting this very remarkable expedition, and nothing but admiration for those splendid photographs, which incidentally prove most conclusively that he certainly did ascend to the extreme summit of Trisul. But there is just one point which I should like to make to-night, and it is a point which was suggested to me. As I was leaving the office of the R.G.S. this afternoon, and passing through the Burlington Arcade, in that classic spot I met an ex-Surveyor-General who suggested to me that, as it is impossible, and has always been impossible, for the Survey Department of India to undertake the topographical survey of such remote regions as have been visited by Dr. Longstaff, it might be well if we could press some of these Himalayan climbers into our service in order to obtain certain scientific observations which would be of the utmost value in future. I need not remind you that barometrical observations for altitude are really of very little value. I do not say that they are of no value, because certainly in the absence of any other method of determining altitudes, they are better than nothing; but an observation taken trigonometrically,

that is to say, by an observed altitude from a known height, is a far more conclusive observation for finding the altitude of a distant peak than any barometric determination. Trisul is one of those peaks of the Himalayas which has been exceedingly well fixed. We know precisely its position, and its altitude almost exactly; I say almost because there are certain corrections, certain weaknesses about those observations, which require eliminating, and the greatest weakness is the fact that we never know exactly what tricks refraction may be playing in high altitudes. Now, if an observation is taken from a low station to a high peak, and its altitude is fixed in that way, the error which may be introduced by refraction is considerable. If, on the other hand, the observation can be taken back from that high peak to the point from where the observation was taken, that source of error is entirely eliminated. Not only is it eliminated, but a value for the error induced by refraction is obtained, which will serve a most useful purpose in determining the altitude of other peaks. Now year by year we are demanding from explorers and from mountaineers more and more close observation, more scientific application to their work than has been hitherto accorded to it. I think you will all agree that in late years we have succeeded in getting more. To me it is marvellous how men who succeed in attaining these great altitudes can ever summon up the amount of resolution that is necessary in order to take the persistent and constant observations which are necessary for scientific purposes; but in this case we must ask them to take one more. If they will only observe from those high peaks what the angle of depression is to some point from which that angle of elevation has been taken, they will be doing an immense service to scientific surveying. I think in asking this we are really not asking very much, for it is not necessary to convey any very heavy instruments to the tops of peaks for this purpose, so that I hope in future that amongst Himalayan climbers we may find some who will work hand-in-hand with the professional surveyors in India, and give us real assistance by their observations. Dr. Longstaff has referred to the ascent of Kabru by Mr. Graham. Now, there was never any doubt whatsoever in the minds of any professional surveyors that Mr. Graham did make a very notable ascent, and did succeed in attaining an altitude which had probably never been reached before. The doubt was whether he had ever actually succeeded in reaching that particular peak which he claimed to have reached, and the points on which the doubt arose were not exactly those described by the Chairman. I was here when Mr. Graham's lecture was read, and my conviction was that he had not quite succeeded in identifying his own position. It is quite clear from what we have heard to-night that, whatever point he reached, he did not succeed in identifying Mount Everest, and as he said that he found elsewhere, on looking round him, that the trigonometrical survey of India was all wrong, and that there were mountains where there ought to be valleys, and valleys where there ought to be mountain ranges, there still remains to my mind some explanation necessary for this very extraordinary phenomenon. Is it possible that, whilst he failed to recognize the peaks around him from Kabru, he was actually on the point he supposed himself to occupy? I do not know whether after all these years that doubt will ever be quite satisfactorily cleared up, but it would have been in those days an immense advantage to him had he possessed what Dr. Longstaff possesses—photographic apparatus, and a photographer capable of illustrating the fact that he was on the top of the peak. I have nothing more to say, except to join with others in congratulating Dr. Longstaff on what is certainly a very remarkable and will be a very memorable ascent.

Mr. FRESHFIELD: I propose to call on Sir Martin Conway, but I would first make one remark in reply to Sir T. Holdich's criticism with regard to what I just said about trigonometrical altitudes. In describing them as indisputable, I meant

relatively final. I must point out that twenty years ago, after consultation with Mr. Whymper, I criticized the determination of 29002 feet given for the highest mountain in the world, and suggested that until it had been measured from some points where the effects of refraction were likely to be less serious than in the plains of India, its height could not be considered as absolutely fixed.

Now, I want to ask Sir Martin Conway to tell us something about the so-called *nieve penitente*. You may recollect that two months ago Dr. Workman described having seen in the Himalaya a series of snow-pinnacles similar to those which have been very minutely described by Sir Martin Conway in the Andes. I do not know if Sir Martin is aware of it, but they were seen before him by another South American traveller, who not only found a collection of those extraordinary snow-pillars, but one of them which served as a pedestal for the frozen carcass of a dead horse, what I may call a *cheval perché*. No doubt the unfortunate animal had perished in the snow in the winter. The traveller in question was Dr. Darwin. I hope Sir Martin Conway will be able to tell us whether the phenomena described by Dr. Workman seem to him similar to those which he saw in the Andes, and also whether he accepts Dr. Workman's description of their causes: first wind, and then sunshine. I would suggest that, if these snow-pillars exist in other regions than the Andes, we should find some English and less far-fetched term to describe them. That of *nieve penitente* was derived from a fanciful resemblance to a procession of white-robed penitents.*

Sir MARTIN CONWAY: At this late hour, I am afraid it would be impossible to go very deeply into this question of *nieve penitente*, and I think I should hardly be justified in referring to it at all, if it were not that in one of the photographs, taken, I believe, on Dr. Longstaff's former expedition, there seemed to me to be some appearance of rudimentary *nieves* in the foreground. I saw no examples in the Karakorams, and I have heard of none observed in the Himalayas except by Dr. Workman in the Nun Kun range. It is almost only, so far as I know, in South America, and within certain definite limits of latitude, that they occur. They are certainly a phenomenon confined within regions of low latitude, and they have nothing whatever to do with the wind. If they were caused by winds, they would have been found in polar regions. They are caused undoubtedly by the melting effect of a relatively vertical sun. It is impossible to describe very briefly and without illustration the manner of their origin, but it has been completely and satisfactorily accounted for. One peculiarity that they have is that the major axis of their horizontal section lies always approximately east and west, unless there should be mountains that shade them from the morning or evening sun, when their axes may be somewhat twisted towards south-east or south-west. It was observing this twist and the cause for it that first opened my eyes to the true origin of *nieve penitente*; the explanation I gave has since been generally accepted.

Prof. GARWOOD: In spite of the early-closing rule mentioned by the President, I cannot refrain from adding my congratulations to those which have already been offered to Dr. Longstaff and his companions. There are many points of great interest in the paper. I will to-night allude to only one of these, namely, the character of the valleys below the snow-line, shown on the screen. I think that every one must agree that they are essentially water-cut gorges, and that ice had little or nothing to do with their formation. Again, that stream which appeared to cross a water-shed seems to point unmistakably to a phenomenon that we noticed also in the

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* For observations of this phenomenon in the Andes and on Kilimanjaro and a discussion of its origin, see *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 1908, No. 2, and also p. 449 of the present number.

Sikhim Himalayas, namely, the evidence of an elevation of the whole mountain group at a recent date. The rivers here also appear to have received additional erosive power so as to enable them to cut those wonderful gorges, some of which, I think the author said, were 1700 feet deep. The fact that they have not been widened by atmospheric agents points conclusively to their very recent origin. The retreat of the glaciers shown also in this district is another point of great interest. The presence of "hanging" valleys occurring in the main valleys themselves is a most suggestive phenomenon, and one to which I recently called attention in the Alps. It is very instructive to find the same thing here, proving again that glaciers must, till recently, have protected their beds from the downward erosion by water such as took place in the valley below the termination of the glacier. At this late hour I will only once more add my congratulations on this very admirable expedition.

Mr. FRESHFIELD: We have had a very interesting paper, followed by an interesting and important discussion, in which various points of scientific interest have been raised. I have already informally expressed the thanks of the Society to the reader of the paper, Dr. Longstaff.

Dr. LONGSTAFF: I am afraid I have not made it clear that I was not the leader of the expedition. We all three worked together to the best of our abilities, but if any one of us deserves the title it is Bruce. I will only mention one other matter: Graham's reference to the irreconcilability of his maps with the actual configuration of the country applies to the Rishi valley and not to anything that he saw from Kabru. I would add that our largest cameras were quarter-plate size, as every ounce has to be considered when coolies are not available.

FURTHER EXPLORATION IN THE TIAN-SHAN MOUNTAINS.*

By Dr. GOTTFRIED MERZBACHER.

THE rigour of winter has for some time interrupted my scientific pursuits and forced me to take up quarters here. I make use of the opportunity to communicate some particulars respecting the course of my expedition down to date.

My departure from Munich was made on April 17, 1907, in company with H.R.H. Prince Arnulf of Bavaria, who, chiefly for the sake of the big game abounding in their valleys, had determined to travel in the Tian-Shan. The impulse to the journey came chiefly from the Prince. The invitation to join him with which he honoured me was, however, all the more grateful to me inasmuch as I had for some quite considerable time been cherishing the wish to follow up my researches in the Tian-Shan, and as in a most generous manner His Royal Highness rendered the prosecution of my scientific pursuits practicable. Unhappily His Royal Highness, after a happy hunting expedition pursued without adverse incident of any consequence, and after his return in complete health to Europe, succumbed at Venice, on October 18 last year, to inflammation of the lungs. The early and unexpected death

* Dated "Kulja, February 9, 1908."