night, and which lay deep in places on the ridge. The climbing was nowhere really difficult, but required pretty continuous attention. The rocks were generally, but not always, firm, and the angle continuously steep. We made only short halts on the way, and reached the top at 12.10, having struck the main ridge about 200 yards, I should think, to the right, or N.E. of the actual top. Under favourable circumstances the expedition would, no doubt, take less time. The German, I was told, had not kept to the ridge, but had for the greater part of the way followed the snow and rocks to the left of the ridge. We were prevented from doing this by the fresh snow. Our route was, I should think, the safer of the two. In fact, except for the snow-couloirs at starting, it was quite safe all the way. The expedition is a fine one, and deserves more attention than it has had hitherto. I send a rough sketch which may explain our route. It is drawn from a photograph taken by W. Leaf from a point near the Unter Allalin Horn to the S.E. of the Dom.

Yours ever,
G. W. PROTHERO.

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## EXPLORATION IN SIKKIM HIMALAYA.

BY COLONEL MICHELL, COMMANDING 13TH BENGAL INFANTRY.

[By the courtesy of the Indian Government we are enabled to print the following most interesting account of work done in its service by a member of the Club. One or two passages bearing more directly on military science have been retained, as furnishing an answer, if any be needed, to those who question the practical value of mountain training.]

I LEFT Pakyong, June 18, 1889, with two sepoys and twelve coolies, carrying ten days' provisions, and marched 12 miles to Guntok, altitude 5820′.

*June* 19, 1889.—Mr. J. C. White, Political Officer, who wished to obtain a more accurate knowledge of the high ground dividing Chumbi from Sikkim, agreed to accompany me, and we journeyed together from Guntok. We marched 13 miles to Lagyapla, altitude 10,700′. Leeches were exceedingly numerous and troublesome from Kangshu, 6250′, to Mirreh, 10,000′; they literally swarmed on the coolies' legs, while ponies and dogs had their bodies, nostrils, and eyes clustered with them. As it would have been impossible to camp on any ground where these pests abounded, we determined to push on to Lagyapla, 10,700′, which was above their range; rain fell in torrents, and the march was most laborious to the coolies, the road being very bad and steep (an ascent of 6000 ft. in seven miles).

Arrived at Lagyapla at dusk, still raining heavily. We

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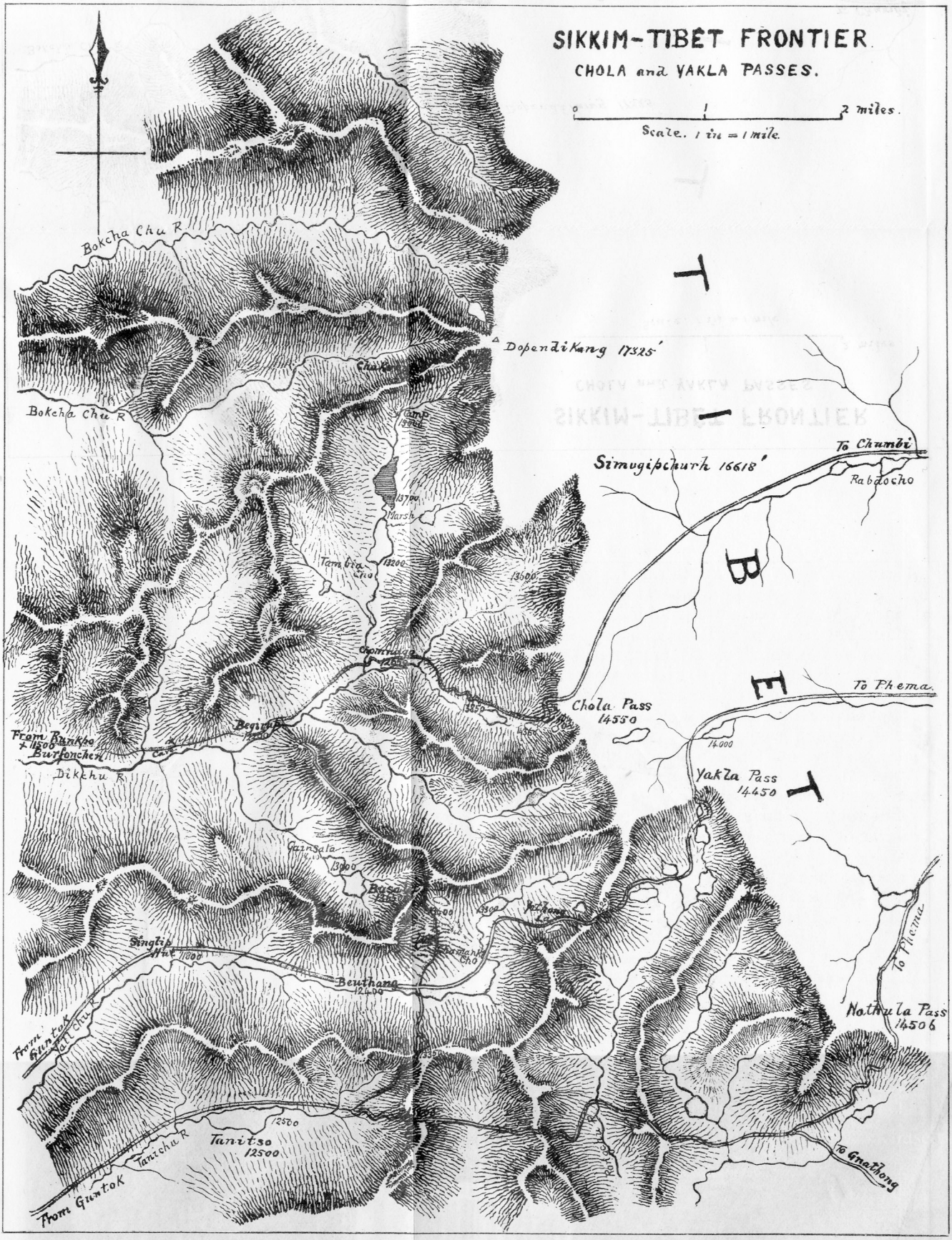
SIKKIM-TIBET FRONTIER
CHOLA and YAKLA PASSES.
0 1 2 miles.
Scale. 1 in = 1 mile.
Bokcha Chu R
Dopendikang 17325'
Bokcha Chu R
Simugipchurh 16618'
To Chumbi
Rabdocho
13700
Marsh
Tambia Cho
13200
13600
Chola Pass
14550
To Phema.
14000
Yakla Pass
14450
From Runkpo
+ 11500
Burfonchen
Dikchu R
Gainsala
13000
Singlip
Hut 11800
Beuthang
12400
From Guntok
Yatchu R
Nathula Pass
14506
To Phema
12500
Tanitso
12500
Tanicha R
From Guntok
To Gnathong

found no good ground to pitch our tents, so camped in a spongy marsh; dry fuel was not obtainable and we found it impossible to light a fire; sepoys and coolies went without food, and we contented ourselves with a dinner of dry biscuits.

Though leeches had ceased at this altitude, we were much annoyed by venomous midges, which attacked us in great numbers and made rest impossible.

*June* 20, 1889.—Marched 11 miles up the Yalichu valley. We found the bridge at Ronglambi had been washed away by floods, and all traffic from Chumbi, over the Nathula Pass, that used to come *via* Tanitso, had consequently to be diverted down the Yalichu valley.

We pitched our tents at lower Benthang, a mile below my camp of last year. At this altitude, 12,400′, the climate was perfect: maximum temperature 53°, minimum 47°, and all insect worries ceased to trouble.

Rain, however, was still continuous. I may here mention that we were using single fly mountain service tents, which have been lately issued to native troops, and which I took with me on purpose to test their capabilities in wet weather.

I found them perfectly useless in heavy rain; water simply poured through them, and we were compelled to sleep with umbrellas over our heads and tarpaulins over our bedding.

*June* 21, 1889.—Camp halted at Benthang. Mr. White and I visited the Yakla Pass.

This route, as far as the Yethongla Pass, has been already described. From that point the Yakla (pronounced 'Yālā') Pass is four miles distant. The road is accurately delineated in the accompanying map; it is bad and unridable, passing chiefly over old moraines. Five small lakes are passed *en route*, the last one, near the pass, was frozen; the one next below it contained floating masses of ice: its temperature was 34½° F.

There was much snow about the pass and the hills on either side were very rugged and inhospitable; the whole scenery was gloomy and dismal. No view was obtained from the summit owing to mist and rain.

We returned to camp Benthang by 5 P.M., having been out 8 hrs.; it rained continuously all day.

The temperature of the air at noon on the Yakla was 44°; its altitude was found to be 14,450′. The pass is marked by the usual cairn of stones and sticks, with coloured rags, and also by a remarkable rocking stone, of about twelve tons in weight, which moves and sways on the slightest pressure.

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A fine lake was just visible through the mist, some 600 ft. down on the Chumbi side.

The peculiar geological formation of the rocks between Yethongla and Yakla, viz. smooth perpendicular walls of rock, flanking the western side of the track, is evidently caused by water entering into the crevices of the vertical strata and there expanding by congelation, thus causing the rock to burst outwards in clean sheets.

The snow on the hills about the Yakla was melting fast, owing to the warm S.W. monsoon current of moist air which was blowing up the Rongchu valley. The corroding action on snow of this warm damp wind was far greater than that of the sun's rays on a bright day; it caused innumerable rivulets to trickle down from every snow slope and fill the lakes below.

In the accompanying map, the positions of the Yethongla and Yakla Passes may be relied on as accurate. The heights have been now determined by two aneroid barometers, which were corrected before starting, by means of a mercurial barometer at the meteorological observatory of Abbé Desgondins at Padong, and all errors again noted when trigonometrical points were met with. The heights, therefore, now marked may be taken as accurate as can possibly be got.

*June* 22, 1889.—Moved camp over the Busala Pass to Chomnago at the foot of the Chola Pass, in the Dikchu valley.

The road (ridable) ascends from Benthang, three miles to the Busala Pass, 13,650′. Two small lakes are met with *en route*, whose names and elevations are marked on the map. At Chamanke Cho, 13,150′, there is good ground to encamp 200 men; rhododendron fuel abundant.

The ground about Busala is level, the ridge being broad and covered with a short nutritious grass, which is excellent fodder for yaks and mules.

On descending to the Dikchu side of the pass, the road, for the first mile, passes through wide, undulating pasture lands, and is in good order; the second mile is through dense rhododendron scrub, and is steep, bad, and unridable; the third mile runs through a mixed forest of pines and rhododendrons, and is also very steep, bad, and unridable. The Dikchu River is met at the end of the third mile. On arriving there we found it a swollen torrent, unbridged and unfordable, and were detained several hours on the left bank, seeking a ford; failing in this, we constructed a rude bridge by felling a large

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pine tree with kookries and knives (there were no felling axes with the party) and letting it fall across the stream.

Chomnago, 12,650′, was two miles up the valley from the point where we crossed.

A herd of thirty yaks, belonging to the Rajah of Sikkim, was grazing there, and we were able to procure a welcome supply of fresh milk and butter.

It rained the whole day.

*June* 23, 1889.—Our camp halted at Chomnago. Mr. White and I visited the Chola Pass, distant five miles. The road was in fair order the whole way, and ridable, except in two or three rocky places, which could easily be repaired. At 400 yards the Chomnago Chu stream is crossed, unbridged but fordable; the road then ascends sharply up the right bank of the Dikchu for a mile, when it leaves the stream to avoid moraines of large boulders which line the banks.

After ascending for another mile, the gradient becomes much easier up to Patheng Cho Lake, 13,850′, three miles from Chomnago. There is room on the northern margin of this lake to encamp 300 men; the place is above the limit of fuel, but there is much bush rhododendron half-a-mile down the valley.

From Patheng Cho the road again ascends rather steeply over stones for a mile to a small frozen lake called Chola Cho, 14,360′. From this spot it is an easy mile of very gradual ascent to the Chola Pass, 14,550′; a small frozen tarn is passed immediately under the pass.

The ridge on which the pass is situated is flat, and forms a curtain of about 600 yards between two flanking high hills, with steep snow slopes leading up to them. If this position were held by the enemy, it would not, I think, take long to dislodge him. A direct front attack could be delivered, owing to the favourable nature of the undulating ground on approaching the pass, which would give cover to the attacking troops.

If the pass were held in strength and fortified, a feint could be made of a direct front attack, combined with a real flank attack from the hills which dominate the pass on either side. These flank movements would be slow and laborious, owing to the steepness of the ground, but they are quite practicable, and could not fail to turn the enemy out.

On returning to Chomnago from the Chola Pass, we determined to explore the Chomnago Chu valley, which is little known, even by the Bhotias, and the survey people do

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not seem to have entered it. There is no road or track leading to it, but striking off from Patheng Cho, we walked along the mountain sides, which were very rough, from the débris of large rocks which had been detached from precipices above.

The valley is narrow and the mountain chain that confines it is the highest and most precipitous on the frontier. There was no sign of a feasible path across the rugged pinnacles of rock that extend from the Chola Pass to Simugipchurh, and there would, therefore, be no fear of a flank movement from Chumbi intercepting an advance on the Chola from Chomnago.

We returned to camp by a steep track under the large cliff which overhangs Chomnago.

*June* 24, 1889.—The reconnaissance, for which I had come out, was now completed; but I was anxious to explore still further that part of the high frontier which extends from Simugipchurh to Dopendikang, and, if possible, to scale the summit of the latter peak. I had in a former report expressed this desire and pointed out certain advantages accruing therefrom.

In spite, therefore, of threatening weather, we took a diminished camp and moved from Chomnago into the Tambiacho valley.

A well-marked yak track led to the Tambiacho Lake, 1¾ mile, altitude 13,200′, a fine but shallow sheet of water, 600 yards long by 400 broad; the northern end of this lake is silting up and has formed a marsh 300 yards long by 250 broad. One mile up the valley from Tambiacho is another fine marsh, which must have been a lake a few years ago and has now silted up; its extent is 700 yards by 400, and its altitude 13,700′. Threading our way through this marsh we climbed up along the right bank of the stream that feeds it for 450 feet, and at the end of a mile came to a flat moraine, altitude 14,150′. This was a convenient place for pitching camp, as snow had melted off the ground and fuel was obtainable a mile down the valley, but the spot was too distant for our next day's work. We therefore continued to ascend, taking some dry fuel with us, and at 1½ mile higher up, altitude 15,000′, we came to a vast snowfield and decided to camp on the edge of it. It sleeted here a good deal in the afternoon, but on the whole we were surprised at the mildness of the temperature; the minimum in our tent was 36° and maximum 43°. We could not afford the

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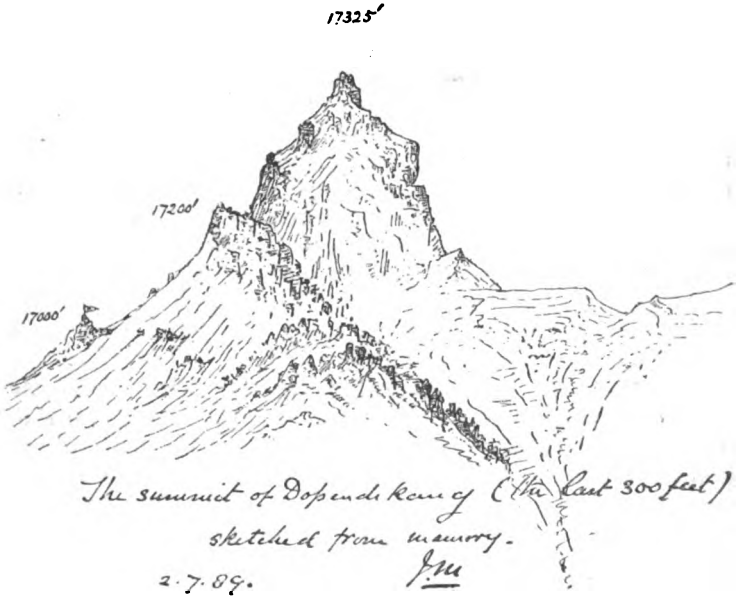


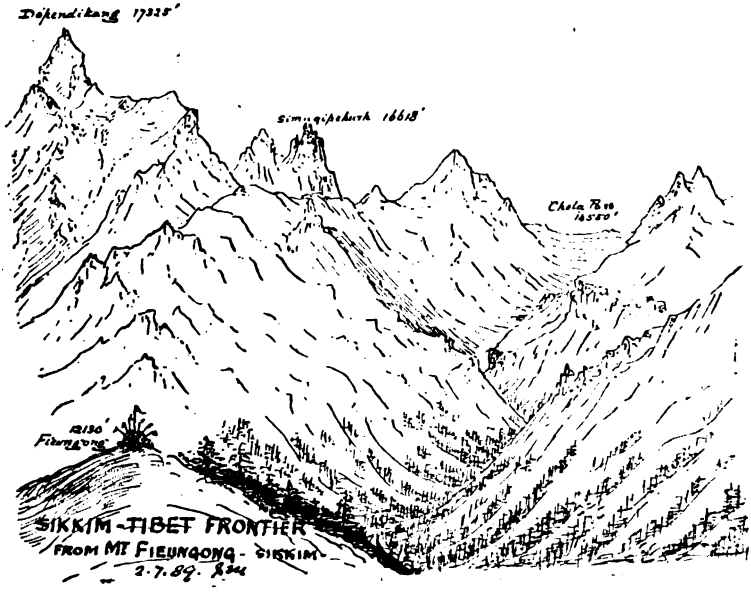


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luxury of a fire, as the wood we brought with us was only sufficient to warm our food.

In the evening we explored the ground two miles beyond camp, ascending as high as 16,000′, and decided on the best way of attempting the ascent for the morrow.

*June* 25, 1889.—Weather very bad and misty this morning. We meant to start at daybreak, so as to allow fourteen hours for getting to the top of Dopendikang and back to camp before dark, but we had to wait till 8 A.M. before it lightened, and we then made a start. We took three hardy Bhotias and one sepoy with us; two of the men were told off to carry a young pine tree, which was cut at Chomnago, to act as a flagstaff; the other carried a flag, a 60-foot rope, and some food.

We first of all worked our way through deep snow for 1½ mile, till we reached a depression on the western ridge, which a Chomnago Bhotia called 'Chakung La,' as he said it was possible for a man to reach Chakung on the Teesta by this route, though of course there is no road or track leading to it. The elevation of this so-called pass is 15,500′, and the depth of snow on it was 9 feet.

We had decided to stick to this ridge as long as possible, as being the safest line to take; it was dangerous to leave it, for rockfalls and snowslips were constantly coming down the steep slopes on either side.

We worked laboriously up from 8 A.M. to 2 P.M. and had then attained a height of 17,000′, the snow here being 15 ft. deep.

The intervening ground was a mixture of steep snow slopes and rugged rocks over which we scrambled as best we could. But at this elevation the ground became dangerous; it was exceedingly steep and covered with hard, smooth glacier ice, all the more treacherous from being covered with a thin 2-in. mantle of fresh-fallen snow; the rocks, too, instead of being firm, were loose, rotten, and disintegrated, and the slightest pressure of foot or hand on them displaced tons of stones, which threatened to engulf us at each step.

It was impossible for the men, at any rate, to go further without risking their lives, so we called a halt and planted the flag on an abutting rock at 17,000′.

After a while I attempted to ascend still higher, and succeeded, not without much exertion and danger from falling rocks, in attaining an elevation of 17,200′, i.e. 125′ below



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the apex of the peak. At this point, however, a snow storm came on, and the wind blew with great violence, hurling masses of rock into the chasms below; it was not possible to see more than five yards ahead, but I got one glimpse of the summit of the mountain, when the mist cleared for a moment; it seemed to be a perpendicular mass of crumbling rock, and I despaired of ever reaching the top in such weather and without the usual appliances for Alpine climbing. With much reluctance I therefore returned to the men below, and found the descent far more perilous than the ascent, for each step I took loosened a small avalanche of rocks and ice.

At 4 P.M. we began the return journey to camp, snow falling very heavily and obliterating the marks of our footsteps.

When we had proceeded half-a-mile we came to a long steep snow slope, which ended in the level snowfield where our tents were pitched; glissading down this at a rapid pace, we covered in seven minutes the ground we had taken six hours to ascend; the glissade was a mile in length and 1500 ft. in vertical height.

We arrived in camp safely before sunset; the sepoy pluckily slid with us down the glissade, but the Bhotias were frightened and picked their steps down the descent, coming in 2 hrs. after us.

I have sent for Alpine gear, and hope to have an opportunity in finer weather of once more attempting the ascent and planting a flag on the summit of Dopendikang.

*June* 26, 1889.—Returning to Chomnago we picked up the remainder of our camp there, and moved down to Burfonchen, 11 miles, altitude 11,500′, in the Dikchu valley.

*June* 27, 1889.—Marched to Runkpo, 14 miles, altitude 5950′. The road from Fieungong down was much cut up by rain and will require repairs to make it ridable.

*June* 28, 1889.—Marched to Guntok, 12 miles, altitude 5820′, by the short cut *via* Satak village; the bridge over the Dikchu R. (Durbar Road), which was washed away, not having been yet repaired.

*June* 29, 1889.—Rode in to Pakyong, 12 miles, altitude 4650′.

## General Remarks.

*Weather.*—We were most unfortunate in our weather; the monsoon set in the day we started, and after ten days and nights of continuous rain, the first fine break occurred on the day we returned. What were insignificant streamlets a

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month ago were now torrents, which delayed us not a little on the march.

*Physical Features.*—In traversing the high ground on the Sikkim frontier, one cannot help being struck with the number of lakes and tarns that dot the upper valleys. Some geological convulsion apparently caused a subsidence of the hills below an altitude of 12,500′, leaving the drainage to collect in pools in the comparatively level dales of greater elevation; it is remarkable that there are no lakes below 12,500′, and that most of the hills are excessively steep from that altitude downwards.

Another physical peculiarity is that snow lies deep on the western slopes of this high region, while those sides of the hills which have an eastern aspect are clear of snow and covered with short grass.

This would prove what is known for a fact, that the mornings in spring time are invariably fine, and the afternoons cloudy; the rays of the morning sun hit the eastern slopes and soon denude them of snow, while the western slopes never receive their warmth at all; hence the abundance of snow on that side.

*Vegetation.*—Between 13,000′ and 14,000′ the ground was carpeted with a luxuriant growth of flowers, the most prominent of which were five kinds of primulas—white, buff, yellow, mauve, and purple—the marsh marigold, buttercups, anemones, and the yellow snow poppy.

Most of the rhododendron tribe had already blossomed, but the orange, pink, and yellow-coloured ones were still in bloom, between 11,500′ and 13,500′.

The limit of pines is variable; well-grown trees were found as high as 13,100′ in sheltered nooks; but as a rule they are seldom met with above 12,900′.

The dwarf aromatic rhododendron was seen as a shrub, 9 in. high, on the Yakla Pass, 14,450′. The giant rhubarb I was surprised to find quite common at 15,500′ near Chakung La, and grasses at 15,000′.

At 17,000′ the only signs of vegetation were mosses and lichens, which were found attached to sheltered pieces of rock; but above that altitude vegetation was conquered and ice reigned supreme.

I searched for the Alpine 'Edelweiss' and Canadian 'tripe-de-roche,' but failed to find them.

*Sport.*—Monal pheasants and woodcock were very numerous in the Tambiacho valley above the marsh marked 13,700′; musk deer and blood pheasants (*Ithaginis cruentus*)



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on the Chola route, under Patheng Cho Lake. Flocks of wild sheep, Burrell (*Ovis nahura*), come over from Chumbi in October and feed in the Chomnago Chu and Tambiacho valleys; we saw numerous marks of them in both these places.

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## Leaves from the Diary of the late Mr. A. T. Malkin.

### 1843.

### *The Straleck.*

*August* 1. *Grindelwald.*—'Eagle' comfortable and civil as ever, and the valley more beautiful than ever. The three great buttresses of the chain coming down into the valley are unsurpassable by anything in Switzerland; and the glaciers, dirty as they are, add a great charm to the scenery. Took a starlight walk; the night most superb, and the valley by that light singular and ghostly. I have seldom seen the stars shine more brightly.

*August* 2.—Another glorious morning. Not a soul but myself in the house now. One English party last night. Visited the lower glacier. Vault of ice large and beautiful. Started for glacier about 3, and arrived at chalet on Zäsenberg in rather more than 3 hrs., easy walking. Bed rather better than usual, being, in fact, two long feather beds of hay. Only goat's milk (only goats and sheep and a few calves pasture here), which does not make coffee as good as cow's. Gave 2 francs, with which the shepherd seemed content. Clouds from the N., and thunder and heavy rain before 10 o'clock at night. Plenty of avalanches all the way. The glacier is dirty, though not so bad as the Aar Glacier. One of the *moulins* of great size and beauty. Crevasses large, not very clear. The path to the glacier, which struck us as being so precipitous the first visit, seemed nothing out of the way this time.

*August* 3.—Morning doubtful, but the rain ceased, and though the clouds hung about the mountain-tops we made a start at 5. Took the shepherd to help us. Crossed the glacier again with little interruption from crevasses by 5.50, and began a desperately steep ascent up rocks intermixed with grass. No real danger as long as the head is steady, for the foothold is always sufficient. Continued in this way along the side of the Mettenberg, steep climbing varied by steep beds of snow till 7.15, when we again took in earnest

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