

## THE GLACIERS OF KANGCHENJUNGA.\*

By DOUGLAS W. FRESHFIELD.

THE Himalayan explorations on which I propose to base a few observations this evening were made in the autumn of 1899—two years ago. I have delayed offering any account of them to this Society for what has seemed to me a sufficient reason. It would have been easy, at an earlier date, to entertain you with a picturesque tour. But I was desirous not to talk about my travels to an audience which comprises at least a proportion of geographers, before my companion, Prof. Garwood, and I had had time to work out some of our results, and in particular to prepare a map, which, in contrast to its predecessor, the official survey, might, if incomplete in some portions, serve at least to indicate approximately what have never been indicated before—the glacial features of the Kangchenjunga group.

To this task Mr. Garwood has given infinite pains and patience. Using as a basis the trigonometrical determinations of the positions of the great peaks made in the course of the Survey of India or of local surveys, he has filled in and corrected the often vague or incorrect detail of existing maps by means of plane-table and other observations with the aid of the numerous photographs taken by Signor V. Sella and himself.

For nearly half a century I have been familiar with the Alps; I have visited more than once the Apennines and the Pyrenees, and have explored much of the Caucasus. I desired to see, before it was too late, some corner of the greatest mountain system in the Old World, the Himalaya.

Let me begin by explaining my reason for selecting Sikkim in preference to the Western Himalaya, where Sir Martin Conway went, and Mr. Mummery disappeared. For a traveller in search of the picturesque, a mountain's height must be measured from its visible base. The vale of the Rungeet, the visible base of Kangchenjunga in the Darjiling view, is 27,000 feet below its summit. The vast extent of the slope embraced in a single prospect gives unique sublimity to the landscape as a whole; while the succession of belts of vegetation piled one upon the other adds exquisite variety to the foregrounds through which a traveller approaches the snows. He sees at one glance the shadowy valleys from which shining mist-columns rise at noon against a luminous sky, the forest ridges, stretching fold behind fold in softly undulating lines—dotted by the white specks which mark the situation of Buddhist monasteries—to the glacier-draped pinnacles and precipices of the snowy range. He passes from the zone of tree-ferns, bamboos,

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\* Read at the Royal Geographical Society, December 9, 1901. The map illustrating Mr. Freshfield's journey will be published with an explanatory note in an early number, together with Prof. Garwood's address.

orange-groves, and dal forests, through an endless colonnade of tall-stemmed magnolias, oaks, and chestnut trees, fringed with delicate orchids and festooned by long convolvuluses, to the region of gigantic pines, junipers, firs, and larches. Down each ravine sparkles a brimming torrent, making the ferns and flowers nod as it dashes past them. Superb butterflies, black and blue, or flashes of rainbow colours that turn at pleasure into exact imitations of dead leaves, the fairies of this lavish transformation scene of Nature, sail in and out between the sunlight and the gloom. The mountaineer pushes on by a track half buried between the red twisted stems of tree-rhododendrons, hung with long waving lichens, until he emerges at last on open sky and the upper pastures—the alps of the Himalaya—fields of flowers: of gentians and edelweiss and poppies, which blossom beneath the shining storehouses of snow that encompass the ice-mailed and fluted shoulders of the giants of the range.

If there are mountains in the world which combine as many beauties as the Sikhim Himalaya, no traveller has as yet discovered and described them for us.

Every journey is the better for having a distinct and feasible aim, and I made mine the tour of Kangchenjunga and the exploration and delineation of its glaciers. I was recently asked, and that in a literary club, what and where Kangchenjunga is, whether it is a mountain or an island? I would not venture to impute similar uncertainty to any Fellow of this Society; but, observing that there are strangers present, I may perhaps venture briefly to remind them that Kangchenjunga is a mountain, that it is 28,156 feet in height—is therefore the third highest measured mountain on the face of the globe—and that it is situated some 350 miles nearly due north of Calcutta, and some 50 miles north of the well-known hill station Darjiling. It forms the culminating point of a group which rises on the confines of three countries: Tibet, Nepal, and Sikhim—very misleadingly called Independent Sikhim, since it forms part of our Indian Empire. If you ask me how to spell the mountain's name, I am afraid I cannot give a ready answer. The Indian Government—nay, even the Survey Department—has shown no consistency in the matter. I try to follow the form adopted in the latest official documents, but it is breathless work; they have varied in the last twelve months, and are still inconsistent.

The Kangchenjunga group is completely cut off by the Khosi valley on the west from the mountains of Nepal, and by the Teesta valley on the east from the mountains of Bhotan. In this respect it may be compared to the Bernese Oberland range, which is isolated by the Rhone and the Reuss, and, like the Oberland again, the Kangchenjunga group forms no part of a continental watershed. By crossing the lofty snow-clad spur which unites it to the Tibetan highlands, it is just possible to get round the mountain without trenching on any territory



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**THE RHODODENDRONS OF THE ZEMU VALLEY.**



officially recognized as Tibetan, though the present political situation in Lhonak, the western headwaters of the Teesta, is very accurately indicated in the following note in the official Roadbook of Sikhim—we now spell Sikhim mostly with an *h*, but on this point again the Indian Government is undecided—published last winter:—

“The whole of the district drained by the Naku Chu and Langpo Chu is called Lhonak, meaning ‘the black south,’ and is regarded by the Tibetans as their own property, and they very much resent the appearance there of any foreigner.”

The Tibetans have been allowed to establish a guard and a wall across the valley containing the eastern sources of the Teesta at Giagong (a desolate spot about the height of Mont Blanc), thus holding the southern approach to the Kongra Lama pass. As in the Alps round Monte Rosa, the northern pastoral race has occupied the pastures at the heads of the southern valleys. It may reassure alarmists to know that here, as in so many other mountainous regions, it is not the passes but the gorges that form the main obstacles to invaders.

Politics, however, are outside our sphere. Nor will I, geographers though we are, spend the evening in deluging you with orographical details. For I am no believer in the system that finds favour in certain quarters—the system of putting the information properly supplied on a map into an interminable series of sentences stuffed with hard names, and calling the mixture, Science.

My object, as I have already said, was to make the tour—the high-level tour—of Kangchenjunga, passing as near the great mountain as might prove to be possible. This had never been accomplished by Europeans. In the map attached to Sir Joseph Hooker’s travels in Nepal and Sikhim, published fifty years ago, a broad gap was left to the north-west of Kangchenjunga. Across this blank space was printed the following stimulating sentence:—

“This country is said to present a very elevated, rugged tract of lofty mountains, sparingly snowed, uninhabitable by man or domestic animals.”

This gap had been somewhat diminished by the recent wanderings of Mr. White, the Political Agent at the Court of Sikhim, a persevering but too reticent explorer, and of Major O’Connor, who, in 1897 (as the Road-book of Sikhim published last winter informed me on my return from India), penetrated Lhonak, crossed the Chortenima La, a pass at the head of it, and returned through Tibet to Giagong.

On two separate occasions, however, native explorers—pundits employed by the Indian Survey to go where Europeans cannot—claim to have crossed this gap. With regard to the first, the well-known Chandra Das, famous for his adventurous journey to Lhasa, and now a resident at Darjiling, I permit myself to entertain some doubt whether the pass he traversed in 1879, on his way to Tashilumpo,

was identical with the Jonsong La. It is true he says so now, but in his first narrative he called it nothing but the Chatang La, and a pass named Chabok La is shown on maps some distance west of the Jonsong La (*La* means "pass"). Chandra Das's sketch-map is, unfortunately, too vague to be intelligible. But it is to be noted that the late Colonel Tanner, of the Indian Survey, tells us that the Pundit's observations placed his pass considerably west of the Jonsong La. Colonel Tanner concludes that the observations were at fault; but it is at least as plausible that the identification of Chandra Das's pass with the Jonsong La is erroneous. With regard to the second pundit, Rinsing, there is in my mind, despite his odd behaviour when with us, little, if any, doubt that he crossed our pass. This was a most remarkable feat for a native, even for a Bhootia, and Rinsing deserves very great credit for getting his party over with the loss of only two lives, at a late season of the year, what he described, probably with justice, as the loftiest and most difficult pass in this part of the Himalaya. In adopting here the word "difficult," I ought, to prevent misunderstanding, to say at once that I use it in the popular and not in a climber's sense. Some travellers call any path where you cannot ride difficult; in the Alpine Club we restrict the term to places where an active man is in danger of tumbling. There are none such on the Jonsong La, though there is plenty of scrambling over rough ground, and there may be danger at times from falling stones or bad weather. Allowing for the difference of scale in the two ranges, the Alpine pass to which it may most fairly be compared is the well-known Strahleck, between Grindelwald and the Grimsel.

It is to this journey of Rinsing, to which I called attention in the *Alpine Journal* at the time, that, as Colonel Gore tells me, Indian geographers and cartographers have been indebted for such knowledge as they possess of the north-western slope of Kangchenjunga. The information Rinsing brought back was embodied in a sketch-map, a copy of which Colonel Gore has kindly sent me.\*

As far as the general trend of the valleys is concerned, Rinsing's work, while not free from error, is in the main fairly satisfactory. He did not carry his map, nor can I carry my commendation much further. Rinsing, by the kind order of his superiors, accompanied us into what, in a memorial he presented to me before we parted, he poetically described as "the jaws of Death." I had therefore full opportunity of observing his method. Sitting in a snug tent and filling in subjective details was much more to his taste than scrambling over rough moraines with a plane-table. As travellers, as observers in the ordinary sense of the word, both he and Chandra Das doubtless deserve our

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\* This and the other official sheets are in the R.G.S.'s collection, and were exhibited when the paper was read before the Society.

esteem; their narratives are full of local information, and often extremely entertaining. For example, nothing can be more graphic than Chandra Das's descriptions of how he suffered from the rarity of the air, how he was carried uphill on his comrade's back with his eyes shut, how he "embarked on a slide, met with slippery ice, and consequently got pains on the back, caused by friction." But it would, in my opinion, be a mistake to regard them as scientific cartographers in the technical sense of the term.

To get round Kangchenjunga was not the only object I set before me. I hoped also to obtain, what up to the present time the Indian Survey has been too fully engaged elsewhere to give us, some accurate idea of the glacial features of the group, some material for comparing them with those of the Alps and the Caucasus. I hoped to be able to ascertain the number and length of the main ice-streams, the amount of ground covered by snow and ice, and any peculiarities which might distinguish the glaciers from those of more temperate regions.

I am now in a position to give a fairly complete estimate of the glaciers of Kangchenjunga. Four glaciers radiate from the peak, pointing roughly to the north-east, south-east, north-west, and south-west. These are the Zemu Glacier, 18 miles long, and the Talung Glacier, both draining to the Teesta; the Kangchen Glacier, 15 miles long, and Yalung Glacier, both draining to the Arun and the Kosi. The forked spurs that protrude south and west from Kangchenjunga, dominated respectively by Kabru and Jannu, enclose in the first case the Alukthang Glaciers, united not long ago in a single stream, and now divided by little more than their moraines, and the southern glaciers of Kabru, which fall into a separate glen; in the second case, three considerable ice-streams, one of which almost meets the Kangchen Glacier at its lower extremity, the second builds across the valley, out of the rockfalls of the tremendous cliffs of Jannu which encompass its source, a remarkable wall of moraine stuff, similar to those of the Allalein, or the Brenva in the Alps, while a third fills a glen, the stream from which joins the Kangchen torrent at Khunza.

I must not omit, though I was unable personally to explore them, the minor but considerable ice-streams that are seen from Darjiling and Gantok to flow from the southern slopes of Simvoo and Siniolohum or those surrounding the base of Narsing and Pundim, which, in default of any particulars from Mr. White, have been laid down from our sketches and photographs with a certain vagueness.

The ice at the base of the Zemu and Alukthang Glaciers descends to 13,000 feet; this is about its lowest level in Sikhim. Taking into account secondary glaciers, the amount of square miles covered by snow and ice in the group, accepting the 24,340 peak close to the Jonsong La as its northern limit, may be reckoned roughly at 180 square miles.

Next a few words as to the most notable peculiarities of Sikhim

glaciers. To begin at the top, at their sources. We ascertained by means of glasses that the transformation of snow into something like glacier ice takes place within a few hundred feet of the final ridge of Kangchenjunga. *Névé* is found there, as in similar positions on the Jungfrau in the Swiss Alps. In these conditions it may appear strange that we saw or heard so few avalanches. Probably they mostly fall in the heats of summer.

In the upper icefalls the ice is apt to assume strange forms. I may best describe them by comparing them to the earth pillars found in certain friable soils: the glacier is converted, not into Alpine seracs—towers and ridges severed from one another by profound clefts—but into clusters of ice-cones, repeating the same form monotonously. The main glacier is apt to be terribly uneven, a confused labyrinth of huge mounds, stony ridges, and hollows filled with yellow pools, but it is seldom much crevassed. We never had occasion for a rope. Progress is constantly delayed, but seldom stopped. Owing to the steepness of the range, the amount of rock surface exposed, and the rapid disintegration caused by extremes of heat and cold, the trunk ice-streams are buried and hidden under piles of rubbish. Materials enough to build a city are brought down by the gigantic sledge which Nature employs in her mountain architecture. The torrents that flow from these vast glaciers are not, however, in proportion to their size.

The features just enumerated may, I doubt not, find an explanation in the local climate. Intense cold follows on great sun-heat; an enormous deposition of moisture, whether in rain or snow, takes place during many months of the year. Ice under such conditions becomes more plastic or viscous, or whatever term the glacialist of to-day may prefer, it cracks less and is more malleable, it loses more by evaporation. The sun, except in winter, as we learnt to our cost, soon spoils the night's crust that helps the traveller on Alpine snowfields. Rocks, again, are quickly split by alternate heat and frost, and the granite cliffs send down ceaselessly their tribute to the ice-sledge as it glides beneath them. With regard to traces of an ancient extension of the ice, it must be obvious to any trained eye that it has been in recent geological times a good deal lower than it is now. Glacial action may be traced for two or three miles below the present end of the Zemu Glacier. Vegetation and denudation make it difficult to trace it further, but I suspect in some remote age the ice reached Lachen. Throughout Lhonak the surface of the earth shows signs of glacial shrinkage. Lhonak is a region where the conservative action of ice is admirably illustrated in the comparatively shallow valleys and smooth hillsides.\*

\* I may refer to my paper on "The Conservative Action of Ice" in the *Geographical Proceedings*, vol. x. p. 799. I do so with more confidence since several eminent geologists, among them Prof. Garwood, have expressed their general agreement with my argument.





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**KHUNZA IN NEPAL.**  
**Looking North.**

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As you are probably aware, a European Association has been formed, of which I have the honour to be the member for Great Britain, to carry on the work initiated by the Alpine Club of obtaining measurements, from all parts of the world, of glacial oscillations, which are not without considerable importance as indications of climatic variations. I have reason to hope that our records may be extended to India; but there is difficulty in finding ice-streams near enough to permanent stations to be systematically visited, and there have been in the past artificial difficulties arising from the extreme complexity of the departmental system at Calcutta, difficulties which I think may be overcome by the good-will of the present Viceroy, Lord Curzon, towards all reasonable scientific proposals.

I may be expected to add something to the discussion on mountain sickness that continues, without much sensible advance, to fill pages and even volumes in mountaineering literature. I could easily occupy with it the rest of the evening. For *quot homines, tot sententiæ*. No two persons feel mountain sickness in exactly the same way, though mountain sickness, like sea sickness, is a painful reality to the majority of mankind. My party were affected most unequally; Mr. Dover, the Road Inspector, never appreciably suffered—he even gained weight on our tour; Mr. Garwood was for forty-eight hours practically incapacitated, though sunheat on new snow had probably much to do with his symptoms. Most of us, Englishmen and natives, felt, in various degrees, our powers diminished; we experienced an indisposition to exertion, bodily or mental—what Stevenson, writing of the climate of Davos, calls “an underlying languor of the body”—a slackening of pace and increased breathlessness in going uphill. We suffered most on first reaching an elevation of 15,000 to 16,000 feet; there was no increase in our symptoms on rising over 20,000 feet. Some of our men, particularly the Ghoorkhas, walked steadily at that height. I was myself never so uncomfortable as I once was on Mont Blanc. It used to be said no one could climb the last slopes of Mont Blanc without frequent halts. The last time I climbed the mountain, I walked straight up the last 1500 feet from the Vallot hut. In the Himalaya I was able to walk, at the end of our tour, from 13,000 to 16,000 feet without a halt. We and our Alpine guide were sometimes quite exhausted by the struggle in soft snow; but soft snow is killing anywhere. I have seen Melchior Anderegg, one of the greatest of Alpine guides, dead-beat for the moment, at a height of 6000 feet, by tracking a path over the Great Scheideck in winter. I am ready to commit myself to an opinion. Training and habit and attention to diet will not do away with mountain sickness, but they will go on reducing its area and its virulence. We have practically driven the enemy up 8000 feet in the last fifty years. Our successors will, I believe, drive it up the remaining 5000 feet in the next fifty. Kangchenjunga and its still loftier

Nepalese neighbour will one day have a flag on their summits. This is my prophecy. Let who will contradict it. Time will show.

I turn next to cartography, to the maps that include the Kangchenjunga group. Sir J. Hooker's, the first, is based to a large extent on his own observations. It is in the main a route-map—an admirable route-map indicating the local topography of the parts he visited with approximate accuracy, but, unfortunately, on a very small scale. It does not attempt to grapple with the glacial features of the Kangchenjunga group, which he did not closely explore. Moreover, some of the peaks had not at that time found their true positions.

Next comes what I may call the mother-map—the official transfrontier survey, long labelled “Confidential,” on a scale of 2 miles to the inch. On this the great peaks have been placed from distant trigonometrical observations; while a number of the minor summits north of Kangchenjunga appear to have been located and measured by the late Captain Harman and Mr. Robert, who established stations above the lower part of the Lhonak valley. In the portions of Sikhim not penetrated by the survey party, minor spurs and features are indicated with much but often purely conventional detail.\* The valleys west of the Kang La are entirely misrepresented on the authority of Mr. Robert (a copy of whose sketch I have before me). He brings the Yalung valley up within a mile and a half of the Kang La! Hooker's little map is far nearer nature here. The rest of the Nepalese slope is left blank. The sole hint of glaciers is contained in the word “moraine” printed across the valley filled by the lower part of the Zemu Glacier.

I desire to guard myself at the outset against any suggestion that in this plain statement of facts I am attacking the Indian Survey. To do so would be a poor return on my part for the aid and courtesy I have received from its present head, Colonel Gore. Moreover, I do not think the facts cited are in any way a discredit to his predecessors. However interesting to the physical geographer, glaciers have no, or at most a very indirect, political, administrative, or commercial importance, and, until a comparatively recent date, they were ignored in most European surveys. The Indian Survey has had its hands constantly full of work urgently needed by the Government, which had to be done first. Nevertheless it has sent surveying parties into the mountains of Kumaon and the Karakoram. The glaciers of Sikhim have so far had to wait. Its tea gardens had a prior claim. Recently, however, there have been attempts to indicate the glaciers round Kangchenjunga on the new editions of official maps.

If you look at these photographs of recent reproductions and reductions of the Transfrontier Map, you will see that the surveyors have

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\* Sir T. Holdich has informed me that the cartographers were authorized to supply conventional detail where no authentic detail was forthcoming.

been making some endeavour to introduce snow and ice. You may notice a few worms crawling about the heads of valleys. These represent glaciers, to which they bear the same relation that the caterpillars of our school maps do to mountain ranges. They do not exhibit the sources of the ice-streams or their connection with the *névés*, and they stop short miles above the snouts of the existing glaciers. This apparent want of method is, however, I think, not without a purpose. The ordinary conception of a glacier, in the mind of the oriental cartographer, seems to be *bare ice*. The *névé* reservoirs that feed the stream and the moraine-cloaked tongue that descends into the valley are ignored. It is obvious that such representations can be of little value to the physical geographer.\*

It has been from time to time the privilege of mountaineers, such as our late colleague on the Council, Mr. John Ball, and Mr. Wm. Mathews, in the Piedmontese Alps, Mr. Adams Reilly in the Pennine Alps, and more recent travellers in the Caucasus, to criticize and make suggestions, or to furnish material, which have led to marked improvements in the Government Surveys of the countries concerned. I should fail in my duty, did I not endeavour humbly to follow in the footsteps of earlier mountaineers, by suggesting by precept, and, as far as my means allow, by example, the principle on which a glacier map of Sikkim, which will be of value to the physical geographer, may be constructed. I therefore venture to offer, by no means as a perfect or a final map (a complex glacial labyrinth like that of Kangchenjunga is not mapped in a month), but as, at least, a specimen of the right method to delineate glaciers,

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\* The official publications and manuscripts I have had before me are the Transfrontier map (2 miles to inch), 1885; a revision (4 miles to inch), 1889; North-eastern Transfrontier map (8 miles to inch), 1889; Skeleton map of Sikkim (4 miles to inch), three editions, 1892, 1894, 1900; Colonel Tanner's map of Sikkim, 1866; manuscript sketches of Rinsing, 1884-85 (Nepalese slope of Kangchenjunga), and Robert, 1881-83 (district round Kang La). The heights given on these maps appear to be divisible into three classes—

1. Peaks included in the Great Trigonometrical Survey of India, the heights assigned to which have never varied.

2. Lesser summits, particularly those in the chain north of Kangchenjunga, trigonometrically measured by the Sikkim Survey party. Many of these altitudes have been revised, some increased, others diminished, not, Colonel Gore informs me, as the result of fresh observations, but after a recalculation in the office.

3. Miscellaneous heights of passes and places, probably derived from various sources, pundits' or travellers' notes. I give examples of some of the more notable variations: Yumpto La; Transfrontier map, 17,040; Skeleton map, 15,800. Tangchung La; Revised Transfrontier, 17,100; Skeleton map, 1896, 17,840; 1900, 17,840 (misprint?). Thé La; Revised Transfrontier, 17,480; Skeleton, 1892 and 1894, 17,810; ditto, 1900, 16,575. Tobli; Skeleton, 1892, 15,600; ditto, 1900, 14,500. And last our Jonsong La; Sikkim Gazetteer, 1894, 22,300; Revised Transfrontier, 22,000; Skeleton map, 1894, 22,000; Colonel Tanner, 1886, 19,000 to 20,000; Rinsing, 21,500. In Mr. Garwood's map I have inserted the official triangulations in thick type, Mr. Garwood's heights in thin sloping type, and a few heights from miscellaneous sources in brackets.

Mr. Garwood's map. I believe it attains to very fair accuracy of detail in the glacier basins, which we ourselves explored in fine weather. Elsewhere it at least indicates approximately the extent of the ground covered by snow and ice. According to my experience, the best spur to further action is to give people something to criticize. This, at any rate, we have done.

Descending below the snow-level and leaving the glaciers, I have still one or two serious, or scientific, matters to which I ought to invite my readers' attention.

There can, I think, be no doubt that the situation of Darjiling is very far from the best possible for a health resort in this region. It was chosen partly at least for political reasons. It stands on the screen of foothills—it is true, on the north or less exposed side of it, having therefore a smaller rainfall than Kursiong, on the south side, but still on the screen that receives the first fury of the rainstorms that sweep up from the Bay of Bengal. This exceptional exposure was demonstrated forcibly in the great storm (of which more hereafter) of September, 1899. The injury done round Darjiling itself was in part caused by the reckless clearing of forest, and consequent exposure of soft slopes at high angles, caused by the spread of tea plantations. But it was the streams fed by the outer foothills, rather than those from the interior ranges, that swept away their bridges and destroyed villages. The observant visitor will hardly fail to notice in the character of the forests a proof that the worst of the rains strike the foothills and surge up the great gap of the Teesta. Farther west, towards and beyond the Nepalese frontier, the vegetation is less rampant; the valleys at the western base of Kangchenjunga are dry and open compared to the glens of the tributaries of the Teesta. The Vale of Kambachen is not more densely wooded than that of Lauterbrunnen, while the Zemu forests are almost impenetrable.

An ideal summer sanatorium would probably be found in the Chumbi valley, which, for reasons best known to politicians, we did not annex fifteen years ago when we had the opportunity of doing so as a penalty for the Tibetan invasion of Sikhim. But, short of this, there are spots—Lachen, for instance, or the downs at the head of the Singalila ridge—where some kind of health station, which would bear to Darjiling—in climate, at least—the relation the Engadine bears to Monte Generoso, may in the future be established. Difficulty of transport will be alleged, but, looking to the development in the last ten years of mountain railways, these difficulties, though actual, will not, I believe, prove permanent ones. This, however, is a matter for the future, perhaps not a very near future. For the present, one of the great wants of Independent Sikhim is horse-roads. In past years pains and money have been expended on patching up the fantastically circuitous and precipitous native tracks which might, I believe, more wisely have been used in

constructing one or two trunk horse-roads, on lines laid down by experts. I understand the authorization of the Government has been given to steps in this direction, and that some steps have already been taken. My companion in Sikhim—Mr. Dover, now the Road Inspector—writes to me of bridges built, bungalows erected or restored, Lachen and Lachung—the villages in the Teesta valley that correspond to Saas and Zermatt—opened to travellers. The Indian Government already publishes a list of tours and resting-places; it has taken, therefore, the initial steps towards creating a mountain playground for Calcutta. A few more efforts in the same direction, and these comparatively slight efforts, might produce great results. Some 8 miles of new path and a couple of bridges would link Pamionchi to Jongri and the southern glaciers of Kangchenjunga, and enable a horse-party to go up this way and return by the Singalila ridge. Some 10 miles of cutting through the forest would open the Zemu Glacier; a stone bungalow on the plan of an Alpine "Clubhut" might easily be built at the Green Lake at the north-eastern base of Kangchenjunga, at a height of 16,000 feet. The tour of Kangchenjunga must, however, I fear, for years to come be a serious matter, apart from political difficulties, since it means coolies, and coolies are—well, they represent time and money. We can hardly ask the Indian Government to imitate the Canadian, and bring out Alpine guides to aid explorers. A climbing party with such aid might, I think, make the tour of Kangchenjunga in a fortnight from Jongri, or even shorter time, could they force the 19,300 feet gap at the eastern base of the mountain. I say nothing here of the ascent of Kangchenjunga. That is an esoteric matter I reserve for the Alpine Club. Nor need I attempt to add anything on the Flora; we have Sir Joseph Hooker's volumes. I have already alluded to the strange imitative forms of the butterflies. Mr. Garwood, regardless of leech-bites, made a large collection of butterflies and beetles; and Signor E. Sella brought home Alpine plants, which he is endeavouring to naturalize at his home in Piedmont.

I will not detain you any longer with general reflections, but attempt to give you a summary of our journey.

My party was composed as follows: Mr. Garwood and myself, Signor Vittorio Sella, the well-known mountain photographer, and his brother. An Alpine guide, A. Maquignaz of Val Tournanche, also came out with us from Europe. The great snowstorm prevented us from making full use of his climbing powers. To this party were further added, by the kind consent of the Indian authorities, Mr. Dover, now Road Inspector in Sikhim, whose services were invaluable; and Rinsing, the native surveyor, I have already mentioned, who made himself very useful in many ways throughout the journey.

Our camp-followers consisted of a horde of coolies, who diminished by dismissal or desertion from about eighty at starting to thirty or

forty at the end. I hope this statement will not make you think we campaigned with heavy stoves and pianofortes. Our tents were 7 feet square, and of the lightest possible make; our cooking-stoves would each have gone inside a silk hat. As it proved, we had only just enough provisions to carry us through the wilderness. A Sikhim coolie's load is half composed of his own rations of rice, hence the necessity of numbers. We had also an escort of half a dozen Sikhim military police with guns and bayonets, who looked after the coolies, and would have protected us from any of the Tibetan robbers who are said to infest the no-man's-land of Lhonak.

After consultation with the few authorities on the matter, I came to the conclusion that my first business was to get our party to a spot reached by Mr. White and Mr. Hofmann, the Calcutta photographer, near the head of the great Zemu Glacier, east of Kangchenjunga. Maps show a gap of 21,000 feet in the range beyond, the chain dividing Sikhim and Nepal, only 4 miles north of the peak of Kangchenjunga. Should this gap prove practicable for coolies, it would save us the circuitous march to the north, necessary in order to reach Rinsing's Jonsong La, which is marked on maps, whether on his authority or Captain Harman's I know not, alternately as 21,500 or 22,000 feet.

Leaving the new Teesta valley horse-track at Lachen (8800 feet), a village the inhabitants of which are Tibetan in type and manners, we hacked our way, by the aid of our Ghoorkha pioneers, through the rhododendron forests of the glen that checked Sir J. Hooker, and in five days—after the track had been opened it proved a two days' walk for a messenger—we reached a wild goats' pasture and a small green tarn at a height of over 15,000 feet, some 10 miles above the foot of the glacier and within four hours' walk of the extreme source of the ice under the gigantic cliffs of Kangchenjunga. There we established a light camp, leaving our heavier tent and the bulk of our followers some miles lower down.

Next day, full of hope, and in apparently improving weather, I set out with our Alpine guide to reconnoitre. We found our way over rough ice and rugged but flowery hillsides to the very base of the Kangchenjunga precipices. I was within at most, I think, three hours' easy walk of the 19,300-foot gap (it might properly be called the Zemu gap), which, however formidable from the south, is perfectly easy of access from this side. I resolved to move our camp up to the last *terra firma* where there was enough juniper for a night or two's fires. Thence we could, I believe, in the existing conditions, easily have climbed Simvoo, officially known as Siimvovonohim (22,300 feet), and got a full view of the east side of our proposed pass to Nepal, the crest of which we had already seen in profile against the sky from the lower glacier. It lies at the head of a large tributary glacier flowing from the west-north-west, which we had crossed half an hour above our camp. *L'homme*



*propose*; the demons of Kangchenjunga disposed. The sky, which had been deep blue, turned pale, then grey, then almost yellow; thin, ugly vapours gathered upon the great crest. The sun grew sickly, and was surrounded by a lurid ring, coloured from time to time by strange iridescences. The air was perfectly still and very close and warm. Recognizing all, and more than all, the usual signs of bad weather, we hastened to return to camp. When halfway we saw dark mists racing up the valley, and were met by a keen blast. We raced too, and got off the moraine as the first flakes of snow fell. In a few moments the storm was on us, everything was blotted out, and we were guided into camp by the shouts of our Darjiling Sirdar, who had hurried out in search of us. I tumbled into my tent and panted speechlessly for some minutes. I had forgotten that it is inexpedient to run a quarter of a mile, even downhill, when at the level of the top of Mont Blanc.

The history of the next twenty-four hours was a blank—a white page in our diaries. The snow fell heavily all Saturday night and Sunday. In the evening some coolies came up from our lower camp and told us that four men we had sent down the evening before had not turned up, and must be lost. The Sellas proposed that a relief party should set out at once in the darkness. I discouraged such action, feeling convinced that the men, following the fashion of the country, had taken shelter under rocks. I proved to be right.

At dawn on Monday it was, after forty-two hours' fall, snowing as hard as ever. We measured exactly a metre (3 feet 3 inches) round our camp where it had not drifted. The snow had to be cleared off our tent-roofs every half-hour to prevent a collapse. There seemed no reason why the storm should stop, and every reason that we should go. One of the smaller tents was completely buried, and the few coolies with us were naturally frightened and impatient. Even our Alpine guide began to babble of avalanches.

We shall none of us forget that walk to the base camp. We started in a dense fog. At first the snow was so deep that it seemed hardly possible to move more than a few yards. Unladen men went ahead to beat a track; we and the light luggage followed. The work was very laborious, and our progress of the slowest. Sending constantly a fresh man to the front, we floundered along, sinking deeply at every step, and glad when we did not tumble up to our waists in some hidden pitfall. Of a sudden the veil was rent before our eyes, and, incredibly vast and strangely transfigured, white and shining from base to summit, the giants of the Himalaya looked down on the train of miserable ants crawling about their feet. The hot glare reflected from the snow and enhanced by the shining particles of mist was terrific; our faces were scorched, and my lips so badly blistered that, as they were subsequently touched by frost, it was six weeks

before I could eat a meal in comfort. This was a unique experience. We never suffered again from heat or sunburn during our tour.

It was not till long afterwards that we learnt that this calamitous storm, which changed the character if it failed to defeat the main purpose of our journey, was no ordinary incident of Himalayan travel, but the phenomenal outburst which, by the havoc it wrought in and about Darjiling, acquired a world-wide notoriety. Nor, happily, were we aware that some newsmonger at Darjiling had excited our friends in England, by reporting by telegram that there was every reason to believe that we were buried under avalanches which from a distance of 40 miles he had watched falling on the southern face of Kangohenjunga, the opposite face to that on which we were! The modern news-sheet, which makes "the moving accident its trade," is a pest to travellers, except, perhaps, those who travel to be boomed.

Next morning we woke to "set fair." The world was all white; the smoke of our camp-fires alone sullied the blue heavens. The fine weather which, with one break of forty-eight hours, was to last for the remainder of our journey had set in.

But the conditions were altogether changed. The Easy had become Difficult; the snow-level had been lowered 4000 feet. We had hoped to make some high ascent, to force a pass into Nepal from the head of the Zemu Glacier. All such projects had now to be abandoned; to get round Kangohenjunga somehow was all we could hope, or reasonably attempt. Our plan had to be modified to suit the altered conditions—to speak more exactly, the lowered snow-level—which we were henceforth to find at 14,000 to 15,000, instead of 18,000 to 19,000 feet. My companions spent two days in plane-tabling and photographing on the Zemu Glacier. We gazed with ceaseless delight on the peak immediately opposite our camp—Siniolchum, 22,750 feet—the most beautiful snow mountain I have ever seen, perhaps the most beautiful in the world. Its icy sides are exquisitely fluted by avalanches; the snow upon its edges is blown up into fantastic fringes, so thin as to be transparent to the Indian sunshine.

Siniolchum stands with reference to Kangohenjunga and the Zemu Glacier much as the Aletschhorn does to the Jungfrau and the Aletsch Glacier, that is, on the flank of the lower part of the glacier, while Kangchenjunga rises above its head. On the fourth day after the storm we started to cross two passes, the Thangchung La and the Thé La, over which runs a native yak-track, used for the transport of timber and salt between Tibet and Sikkim. In an ordinary year these passes are as easy and not more laborious than the Wengern Alp and Great Scheideck in summer. They now exactly resembled those passes as I once found them in January—that is, they were snow-grinds. The loose snow on the descent was very trying to the coolies, who made many involuntary glissades. Preferring to black their faces, or, in the case of the Lepchas,

to improvise veils with their long locks, rather than to use the spectacles with which I had provided them, they suffered also from snow-blindness.

In three days we reached the lower end of Lhonak, and in two more its head. This district, though on the Indian side of the watershed—in fact, feeding the main source of the Teesta—displays all the characteristics of Tibetan landscape. The shapes of the hills and the foreground are those of an ice-modelled region, like the duller parts of the Highlands. The 21,000 to 24,000 feet peaks which overlook the valley are on much the same scale as those of the Upper Engadine; they rise from 5000 to 7000 feet above their bases. Huge moraines mark the former extent and limits of vanished or diminished glaciers. There is not a tree to be seen; even the grass is scanty; the slopes are brown and yellow, the flats grey and sandy, and strewn with sky-reflecting pools, or flecked with patches of light-blue gentians. The only signs of human habitation from one end of the region to the other are two or three low walls which afford summer shelter to a few Tibetan shepherds and their yaks. We saw nothing of the shepherd-robbers, who, according to Chandra Das, “have charge of the passes,” and in return for their services, are authorized to rob all travellers who venture to cross them. If they still exist, they had all gone north to their homes; but we met and slew a lonely yak. How it came to be there was a mystery. Some said it had been left as a peace-offering to the mountain demons, a scapeyak; others, that it had been driven out of the herd by a stronger bull—a broken horn gave some countenance to the latter hypothesis.

From the head of the valley I and Erminio Sella, led by Rinsing, climbed to a ridge which Rinsing declared to be the Chortenima La. It was not that pass, which, as we subsequently ascertained, lies farther west, but part of a glacier-clad range dividing us from another source of the Teesta. The gap, which we reached by a rough scramble, was between 18,000 and 19,000 feet in height, and commanded a superb view, of which my companion obtained panoramic photographs. Southwards, over a wilderness of fresh snow, we saw the Kangchenjunga group, and our eyes, ranging through west and north to north-east, followed the chain that connects it with the Tibetan plateau. Above the Lhonak glaciers the granite apparently trends away westwards; the range north of Lhonak is limestone.

Three gaps in the ridge encompassing the head of the Lhonak valley were conspicuous. That on our left, between the peaks marked 24,340 and 22,700 feet on official maps, was obviously, though long and lofty, under ordinary conditions free from anything a mountaineer calls difficulty. A steep, but not excessively steep, snow-screen connected the two peaks, while the hollow beneath was filled by smooth glaciers. The ground below the ice is usually bare broken slopes; it was now one vast sheet of snow spread over long hillsides.

To accomplish this most laborious ascent, we took, or rather our coolies took, two and a half days. The distance was considerable, but the actual height to be climbed not over 5000 feet.

Our difficulty was entirely caused by the fresh snow. We waded and floundered through the hours of light with much waste of precious time at the beginning of each day, the result of the incorrigible habit of the coolies of waiting till the sun strikes their tents before they will uncurl and cook their indispensable morning meal.

In this way they lost, of course, any chance of finding the snow hard. The worst part of the climb was the lowest, where we tumbled about among the hidden pitfalls of loose moraines, or waded up a little stream, which we found preferable to wading in the deep snow on its banks. As we mounted, the views grew wider and more majestic: we gazed out to Chomomo and Chumalari, and on a range of unknown peaks between and beyond them. We enjoyed superb sunsets and mystical afterglows, the brilliant colouring of which was enhanced by contrast with the white fields of snow which encompassed us on every side. The final ascent to the pass gave us no particular trouble; the last climb was up a bank of bare loose rock. The actual crest proved a cornice, overhanging an incipient crevasse. We broke a hole through the snow-wave and stood on the top, for which our measurement gives the height of 20,200 feet.

Our first feeling was one of disappointment. Rinsing had been promising us a view over Nepal and the valley of the Arun to "Mount Everest." A ridge a mile off, very little higher than our pass, shut out that view. Our next feeling was dismay, when Rinsing, a comical figure, burnt red as a turkey-cock, and shaking his pigtail mournfully, announced that we were not on the right pass. I admonished him sternly to keep his opinion to himself, for if our coolies once heard it, how should we induce them to persevere?

What we saw was a broad névé basin some 500 feet below us, from which a glacier stretched away down a narrowing trench between rocky walls until it was closed, apparently hermetically sealed, by the huge bulk of Kangchenjunga. To the right, the blunt head of Jannu, oddly like that of the Matterhorn from Breil, rose for the first time over the nearer icy ridges.

From what I had seen three days before, I felt certain that the basin below us did not drain into the Teesta as Rinsing now asserted. Our plane-table, directed on Kanchenjunga and the great peaks, showed that we were approximately in the position assigned to the Jonsong La on the map. After some discussion, we determined to go on; but the lingering of the coolies forced us to camp on the ice again before we had got far. The next day we rambled over the frozen hillocks and down the sloppy dales of the glacier. The afternoon we spent in traversing a rocky slope, in the gullies of which stones rattled dangerously at intervals. We slept



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**KANBACHEN IN NEPAL,  
with Jannu and the dyke of the Jannu Glacier.**



another night, our fifth, on the ice, for on its banks there was nowhere to pitch a tent. Tributaries poured in on all sides their broad billowy icefalls. Kangchenjunga rose up ever nearer and nobler in front. At last, where our glacier plunged down to the meeting-place of ice-rivers under the craggy buttresses of the great mountain, Rinsing, with unexpected confidence, struck up a steep moraine on our right. In a quarter of an hour we were on turf, a pleasant terrace sloping down parallel to and far above the ice. Just at the corner over the junction of five glaciers whose united flood flowed west, or at right angles to our previous course, we pitched our tents on a platform where the snow lay only in patches, and there was dwarf juniper for firewood. Our coolies shouted for joy as they threw off their burdens on the dry turf.

We were safe in Nepal, at the head of the valley of the Kangchen, looking at a sight never before seen by European eyes—the north-western face of Kangchenjunga, not a sheer cliff, like the three other aspects of the peak, but a superb pile of rock buttresses, terraces of snow, and staircases of ice, through whose labyrinthine complexities the future conquerors of the great mountain will have to find the least hazardous way to the summit.

The best part of the next day we waited for stragglers, and gazed at the stupendous scenery. Some of our coolies were still lingering in the rear, and did not catch us up for forty-eight hours, when they reported that they had lost one of their number, who had preferred to remain behind and die to walking any further. We could not make them share, or even understand, our horror at their desertion of their comrade. They simply said, "He did not wish to live; he had a right to do as he pleased." They were, of course, Buddhists.

Many of the coolies were a good deal the worse for the snow; there were among them several slight cases of frostbite and of sore eyes; for to make them use the boots and spectacles provided was a hard matter. But there were no very bad cases, and when Mr. Dover met some of our men twelve months afterwards, they expressed their readiness to go again. I ought, perhaps, to mention that they were volunteers.

We had still two days' march, of which we made three, in order to reach Hooker's old tracks. But it was all downhill. For several hours we trod on meadows of edelweiss beside the huge boulder-burdened glacier. Long green alleys beside the glaciers are a feature of Sikkim, and a great convenience to travellers. Possibly they are preserved by torrents issuing from side glens, which by constantly washing away the lateral moraines restrain the main glaciers from pressing the hillsides. We passed a gap on our right, which presumably leads up to the Chabok La. Here were some at the time deserted shepherds' huts, the first human dwellings we had seen since leaving Lachen twenty-one days before. On our left a fine glacier came straight down from the westernmost of the five peaks of Kangchenjunga, and almost joined that we

had descended. It issued from between two icy ridges. I never saw such perpendicular mountain architecture as that of the spur that overhangs the valley on the left at this point. Kambachen is a group of stone huts, such as may be seen anywhere in the Italian Alps, but is rendered picturesque by numerous chortens and prayer-flags. It was deserted when we passed. It lies immediately under Jannu, which presented its astounding precipices in the morning light.

The next reach of the valley is very beautiful. Forest begins below the Jannu Glacier, a forest of junipers, firs, and some deciduous trees. High cliffs rise on either hand, and the snow-peaks peer above them. But that the walls are granite, not limestone, the scenery might be compared with that of the Lauterbrunnen valley.

At Khunza, a large and populous village and monastery, we came on human beings, and met Sir J. Hooker's track. Considering that only one Englishman had ever visited Khunza, and that half a century before, we excited very little curiosity. The people cross to Darjiling to sell butterflies, so that Europeans were no novelty to them. They seemed well-to-do; large herds of yak, said to be "State property," were pasturing on the meadows, and poultry and potatoes were fairly abundant.\* Their cottages were wood-built in the Swiss style.

We next traversed three passes of about 15,000 feet, on the spur of Jannu, described by Hooker as the Choonjerma. From one of these we had a noble view on one side over Nepal; on the other, of Jannu and its satellites. The blue vault was ringed with wintry snows; round us the upper slopes and valleys were rich in the faded reds and browns of autumn; below these spread the eternal green of the zone of tropical summer; and beyond, again, we could see the pale shimmer of the plains of Bengal. But the centre of the scene (to us at any rate) was the Lapohikang group, with the highest measured peak in the world, the Mount Everest of the survey, the Chomokankar of Major Waddell and the Pundits,† rising behind the splendid dome of Makalu. Owing to our being so far north, it appeared on the northern instead of the southern flank of Makalu, where it is seen from stations on the Singalila ridge. Rinsing consequently could not recognize it! In shape it is not imposing; it looks an "easy mountain." Its outline reminded me of that of the Dôme and Aiguille du Gôttier, Mont Blanc being suppressed. Behind it rose a gigantic rock-peak which is invisible from more southern stations. I regret that I cannot throw any fresh light on the question whether there are—as several native explorers and Mr. Graham have suggested—higher summits north of Everest. We did not recognize

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\* See 'Narrative of a Journey to Lhasa,' by Sarat Chandra Das (Calcutta, 1885), for a detailed description of Khunza.

† See Major Waddell's very instructive and entertaining volume, 'Among the Himalayas' (London, 1899).



any, but we were 3000 feet lower than the Kang La peak, whence Mr. Graham thought he saw them.

From this point we diverged again from Sir J. Hooker's track. Clouds and a snowfall, coupled with failing provisions, prevented any exploration of the glaciers between Junnoo and Kabru, and hindered us from climbing the Kang La peak while crossing the pass of the same name.

We arrived at Jongri (13,100 feet), a yak pasturage with two stone huts, the future Riffel Alp of Sikkim, in driving sleet. Despite broken bridges, Mr. Earle's kindness had sent up our letters and fresh stores by the Singalila route. The fine weather soon returned, but it became much colder. The smaller streams, down to 12,000 feet, remained frozen all day. We climbed Kabru, the local Riffelhorn, 100 feet higher than Mont Blanc. I believe that had we gone first to Jongri, and not encountered the great snowstorm, we might have got up Kabru. It is obviously the most accessible of the great peaks. We tramped north, a three days' march there and back, to the Giucha La, a 16,400-foot pass under Pandim, which has been visited by a certain number of tourists from Darjiling.

We enjoyed sunrises and sunsets, the rose of dawn on Kangchenjunga, the last flush of evening on Kabru, radiant noons and still more rare and radiant full moons; we watched the clouds rising in pillars, like our childhood's friends the genii of the 'Arabian Nights,' from the depths of the valleys; beyond the varied greens of the forest foreground we saw the marvellous sapphire waves of the distant foothills; we recognized in the golden haze of the far-away plains the windings of the silver ribbon of the Teesta, 80 miles off.

At last we turned our backs on the snows. We plunged down 6000 feet in a few hours, through a wild tangle of rhododendrons and bamboos; we spent a long afternoon in tripping delicately across the face of cliffs on frail and ruinous bamboo balconies, or climbing up and down rock staircases and ladders of roots. Such is an aboriginal path, neither difficult nor dangerous in the climber's sense of those words, but singularly vexatious to a weary traveller.\* We accomplished a two days' journey in one, and, in the gloaming, we emerged from the forest, and, leaving behind us the screeches of the green parrots and the chatter of the monkeys, who had seemed to mock our slow steps, we were greeted by a band of yellow-coated Buddhist lamas from the Dubdi monastery, the oldest in Sikkim, who played us into camp at Yoksun with fifes and drums, horns and clashing cymbals.

We had returned to the land of men, of temples and villages. Our march became a progress. At every few miles we found a roadside arbour garlanded with yellow flowers, a table spread with bananas and oranges, and bamboo mugs full of murwa, or native beer.

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\* Mr. White, however, lost a coolie in one of the torrents that cross the track.

At the monastery of Pamionchi, perched on an exquisite hilltop (6600 feet) in a natural park, a devil-dance was performed in our honour—for a handsome fee—by a party of young lamas who were going up to Alukthang to offer a week's service to the demon of Kangchenjunga.

On the fifth day from Jongri, including one of rest at Pamionchi, we regained Darjiling; we exchanged narrow tents or dak bungalows, in which the rain came through the roof, and our feet went through the rotten floor, for European houses. In short, we returned to civilization.

Our journey had occupied in all seven weeks, during which we had ascended and descended some 75,000 feet, or 14 vertical miles up and as many down. We were twenty-four days between Lachen and Khunza without meeting inhabitants, twenty days without seeing trees. Except for a few contributions from our sportsmen, we were during this time wholly dependent on the provisions we carried with us.

I should like my concluding words to be of very sincere thanks to the Indian authorities, who, from his Excellency the Viceroy downwards, in the most generous and sympathetic spirit, did everything in their power to help us in our novel enterprise; and more especially to Captain Le Mesurier, the acting Political Officer in Sikhim, and his wife, who came with us as far as Lachen, and blocked the retreat of our coolies; to Mr. Dover, our most able and energetic and cheerful companion, who ruled the camp with gentle firmness; and to Mr. Earle, the Assistant Commissioner at Darjiling, who sent relief parties to meet us on our return march.

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Before the reading of the paper, the PRESIDENT said: We have to offer our thanks to the Board of Works for the new electrical installation which has been put up entirely for our benefit, and which I believe will be used the first time this evening, when we welcome amongst us our very good friend Mr. Freshfield. You all remember what excellent papers he has given on the Caucasus, and now he is about to describe to us his very remarkable journey round the great mountain mass of Kanchenjunga. I will now call upon Mr. Freshfield to give us his paper.

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

Sir THOMAS HOLDICH: I should like, if it won't detain you too long, just to make one or two remarks about the map which you have in your hands to-night. It is an interesting map, because it represents somewhat a new departure in mapping. You will, at any rate, agree that it is a very vast improvement on its predecessors. Now, Mr. Freshfield has referred to the manner in which the previous maps were made. Any map, made as they were from a distance, must necessarily depend on what we may consider as conjectural topography, particularly as regards glaciers and ice-fields. It will be, as a matter of fact, more or less a fancy map. Now the question is—and I think it is a question which really deserves deep consideration by this Society—whether this new system of making maps by the conjunction of photography and topography, which they now call photo-topography, can ever lift our maps entirely from all regions of fancy on to a solid basis of topographical fact. For my part I am rather inclined to doubt it. The only people that I know who have satisfactorily exploited this system

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are the Canadians, and their verdict, after very considerable experience, seems to be this: That, whereas, under all ordinary circumstances and conditions of atmosphere, the map which results from this process is hardly to be compared for finish and detail with the topographical map carried out by the ordinary process, yet there are certain exceptional atmospheric conditions—where, for instance, from the prevalence of clouds only passing glimpses may be obtained of glaciers and peaks—where the art of photography may come in to the aid of topography. There is one thing, however, that the Canadian map-makers hold to be most important, namely, that the man who takes the photographs should be the man who makes the map. It is difficult enough to make a good topographical map from the features of nature. But it demands even higher training to make a map from a photograph, in which very much of the detail is either lost, or at any rate, very obscure; and for this reason the Americans maintain that the cartographer should be the man who makes the map in the field; that he should be a past master in the art of topography first and a photographer afterwards. Mr. Freshfield was not fortunate enough to secure these advantages. He had, so far as I know, no past master with him. Certainly my old friend Rinsing cannot figure as such, and I doubt whether, under any circumstances, there is any topographer at present of sufficient training to undertake the double duty. Certainly, amongst the latest surveyors of the Indian Survey, I knew no one who united practice in the art of topography and photography. Under these circumstances we must, I think, consider this map as more or less an experimental map, and I think this Society owes a very deep debt of gratitude to Mr. Freshfield for having carried out this experiment with so much ability. In this connection it may be interesting to you to know that in the very much larger fields of glaciers and snowfields which lie to the north-west of the Himalayas, there is a prospect of photo-topography being applied to the production of our maps. I hope to hear soon that the best of our professional surveyors have carried with them their photographic apparatus, and I feel tolerably certain that the result will be that, although there must always be in high altitudes slight elements of uncertainty and conjecture—certainly about the higher peaks—yet that, for all practical purposes, the mapping realized will be quite as accurate as anybody can require.

Mr. A. W. PAUL: I would only like to make one or two remarks. Rinsing was a boy who was educated at the school we started some years ago in Darjeeling, and I do not think he ought to be quoted as a man who can make a map of a journey. On this particular journey to which reference has been made, he was not the head of the party. The head of the party unfortunately lost his life, and it was with very great difficulty that Rinsing and the others escaped; therefore I hope you will not judge him too harshly, if he was unable to find his way back again over a pass which he only crossed once in the opposite direction. I have one other remark to make, and that is with reference to Darjiling being chosen for the station. Surely a good many reasons, apart from historical ones, could be given why that should be selected. I have been over the greater portion of what has been called Independent Sikhim, and doubt very much whether, with all due deference to Mr. Freshfield, you could find a better site for a station than Darjiling. It has a great many faults, but in the first place it is accessible, and in the second place it has water. Now, most places in that district are deficient in this commodity which is absolutely essential; we cannot, therefore, be blamed very much for having stuck to Darjiling. If you only knew the cost of carriage which you would have to pay for the very smallest necessity of life, leave alone luxuries, you will see at once that Chumbi, although very delightful in other ways, is absolutely out of the question.

Dr. BLANFORD: I certainly have some knowledge of Sikkim, but I have never been in that part north and west of Kanchenjunga of which Mr. Freshfield has been talking this evening. In the first place, I have to congratulate Mr. Freshfield on having accomplished a task that has long been very much desired, and I think in addition to this he has done important service to geography in several ways. There are many of us who look upon the view of Kanchenjunga from Darjiling as one of the views of the world. It is very satisfactory to hear from a traveller who has had so wide an experience as Mr. Freshfield, that he agrees in this opinion. I think the upper valley of the Lachung, which is the valley to the east, is more beautiful than the Lachen valley. The Lachen valley, when I passed through it, was singularly inaccessible. Here and there on the route it was necessary to traverse difficult places like that of which an example was shown on the screen in one of the photographs. The Lachung valley was more accessible, and it is interesting on account of the enormous moraines by which it is crossed, and which are the remains of former glaciers. Mr. Freshfield spoke of there being a moraine just over 8000 feet above the sea. This is below Lachen, and there is a specially large moraine in the other valley, and that can scarcely be more than 7000 feet above the sea. The shape of the valley below Lachung is such that it is very probable the glacier came farther down, and this leads me to a point that has been remarked upon by both travellers, and especially by Mr. Garwood, the peculiar form of the Sikkim valleys. I was some time ago talking with a very experienced European geographer and geologist about the remarkable shape of the Himalayan valleys, and I told him it was my impression that people whose experience is confined to Europe may never have seen a valley shaped by pure fresh-water denudation—rain and river. The larger valleys in mountainous parts of Northern and Central Europe have almost always been partly moulded by ice. But, although the glaciers in Upper Sikkim undoubtedly came down in places to about 7000 feet, there are no glacial markings in Lower Sikkim. The whole of the denudation is pure fresh-water denudation, and this is of great antiquity, for, although the evidence has not been found in the Eastern Himalayas, in the Western Himalayas there is clear proof that the valleys which now cut their way out of the mountains were cutting their way out long before the glacial period, in Pliocene and perhaps even in Miocene days. I will not detain you any longer; I can only congratulate Mr. Freshfield and Prof. Garwood on the results of their journey, and on the very beautiful examples they have brought back with them.

Mr. FRESHFIELD: I have only a few words to say with regard to the various remarks made by speakers. With regard to Sir Thomas Holdich's remarks, I entirely agree that the work of a trained staff of surveyors is the best thing you can have. But how many years will it be before the Himalayas can be surveyed in that way? In the mean time, need we be content with the "conjectural topography" of the existing Survey maps, or may we endeavour to supplement it by means of the camera and plane-table, in the use of both of which my companion, Mr. Garwood, had had previous practice? With regard to what Mr. Paul said of Rinsing, I did not quote him as in any way responsible for our map produced to-night, nor did he furnish me with the material used in its construction,\* though he was most useful to us as a local guide and in many other ways. I quoted Rinsing as the sole cartographic authority Colonel Gore, the present Surveyor-General, could refer me to for the Nepalese valleys west of Kangchenjunga,

\* With one exception, the central portion of the Talung Glacier, for which he is mainly responsible. For further details, see the note which will accompany Prof. Garwood's map.

and I exhibit to-night in the tea-room the manuscript map of those valleys made by Rinsing on his previous journey, and kindly sent me by Colonel Gore. With regard to the sites of sanatoria which may in the future supplement or rival Darjiling, bearing to it a relation similar to that of the Engadine to Monte Generoso, I think any detailed discussion would be at present premature. I regard this as a question of the future; its solution depends chiefly on the construction of light mountain railways similar to those which are being constructed everywhere in the Swiss Alps. Mr. Blanford's praise of the scenery of the Lachung valley I entirely endorse. I was fortunate enough to walk up the lower portion of it, nearly as far as the chief village.

The PRESIDENT: It remains for us to thank Mr. Freshfield for his paper. He has led us into a most important and most interesting geographical subject. One's mind goes back to the time when those great peaks were first measured, fifty years ago, when the Himalayan series—I believe the longest between two measured bases that ever was taken—when that series was measured along the foot of the Terai, in so noxious a climate that over forty or fifty of the native surveyors and three officers died, and I believe that party had to be renewed more than twice. It was under such tremendous difficulties that seventy of those peaks were first measured. A long period has elapsed since then, and it has not been possible, owing to the pressure of work in other parts of India—and most marvellous work it is, that work of the Indian Survey—owing to political difficulties, and still more owing to financial difficulties, for surveyors to reach the bases of those peaks, or the greater part of them; and their glaciers have not been explored. It is a matter for the future. This is one of those great regions of the Earth which are unknown and unexplored, and we look forward to the extension of our knowledge there at some future time. But there can be no question with us to-night that Mr. Freshfield has made a most remarkable commencement of that exploration by his journey to Kanchenjunga. We have to thank him for a most interesting paper, which included that very eloquent description of the beauty of the scenery passing through the valleys to the higher land at the foot of the ice, and we have to thank him for the marvellous series of photographs which have brought still more clearly to our minds the beautiful description which he gave of that scenery. We also have to thank Mr. Garwood for his interesting remarks on some of the physical features of the country, especially respecting the hanging valleys. I would ask you, therefore, to pass a very cordial vote of thanks to Mr. Freshfield for his paper, and to Mr. Garwood for his address, and for the very beautiful series of photographs, taken by Signor Sella and Mr. Garwood, that Mr. Freshfield has shown to-night.

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## THE RUSSIAN POLAR EXPEDITION IN THE "SARYA."

By Baron ED. VON TOLL.

LEAVING St. Petersburg on June 21, 1900, the *Sarya* first touched at Kronstadt and Revel. At the latter port, on June 26, I quitted the ship to go by way of Helsingfors, Stockholm, and Christiania, to Bergen, whither, under command of Lieut. Kolomeitzov, the ship steered a straight course. At Christiania I was indebted to Prof. Nansen for many valuable advices and suggestions. On July 3 I caught up the *Sarya* at Bergen. Here from different towns were