ICE-BOUND HEIGHTS OF THE MUSTAGH

AN ACCOUNT OF TWO SEASONS OF PIONEER EXPLORATION AND HIGH CLIMBING IN THE BALTISTAN HIMÁLAYA

BY

FANNY BULLOCK WORKMAN
Officier de l’Instruction Publique de France, Grand Medalist of the Club Alpin Français, Membre d’Honneur de la Société de Géographie de Nancy, Charter Member American Alpine Club, Fellow Royal Scottish Geographical Society, Member Royal Asiatic Society, Corresponding Member Brooklyn Institution Arts and Sciences, Corresponding Member Appalachian Mountain Club, Corresponding Member American Geographic Society, Member French, German-Austrian, and Italian Alpine Clubs

AND

WILLIAM HUNTER WORKMAN, M.A. M.D.
Fellow Royal Geographical Society, Corresponding Member Appalachian Mountain Club, Charter Member American Alpine Club, Member Alpine Club

AUTHORS OF
"THROUGH TOWN AND JUNGLE," "IN THE ICE-WORLD OF HIMALAYA," "SKETCHES A-WHEEL IN FIN DE SIÈCLE IBERIA," "ALGERIAN MEMORIES"

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PRESS NOTICES OF "THROUGH TOWN AND JUNGLE," BY SAME AUTHORS

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All Illustrations are from Photographs taken by the Authors.

The large map of the Chogo Lungma and adjacent region explored by the Authors is based on a theodolite survey by Mr. B. H. M. Hewett, corrected and supplemented by the Authors from actual observation and photographs.
NOTE. This map is from a theodolite survey by Mr. R.H.M. Howett, corrected by W. Hunter Workman and Mrs. Howey Bullock Workman, adjusted to fixed points of the Indian Government Survey as laid down on Sheet 27 N.E. of the Indian Atlas with the correction to longitudes applied.

The lines lettered A & B on the Chogo Lungma Glacier, and C on the Hoh Lumba Glacier, show where measurements of the movements of the ice were made.
CHAPTER I.

Difficulties to be overcome by the Private Explorer—Spring in Vale of Kashmir—Routes to Baltistan—Dras and Indus Valleys—Oases and Irrigation—Camping Places—Water-Erosion—Reception by Raja of Tolti.

The adage, "Too many cooks spoil the broth," is as true in exploration and mountaineering as in cookery. The fewer the leaders of an expedition, the more complete the unity of purpose, the less the danger of dissension and the greater the chances of success. Without doubt, on many accounts, the best number of leaders is one, if that one can endure the loneliness of the situation and the weight of care and responsibility thrown upon him. If he cannot, the next best number is two, provided there be sympathy and agreement of aim between them. Beyond this, divergence of views and consequent paralysis of effort, leading to failure, are likely to increase in proportion to the number involved.

It must be borne in mind, that a private expedition undertaken by one or two persons implies a greater amount of mental and physical exertion on their part, than falls to the lot of the head of an expedition sent out by a government or society, inasmuch as in the latter case, in addition to the
authority behind the expedition, which makes the question of ways and means an easy one for the participants, the commander is assisted by a staff of men trained in their own lines, who relieve him of the labour of attending in person to the details of the different departments.

In a private expedition, the leader or leaders have to furnish the means, provide all outfit and supplies, establish and maintain a commissariat service, get together, support and direct, assistants, servants, coolies or porters, put up with their idiosyncrasies, look after them in sickness and health, like so many children, take them over difficult paths, encourage them when faint-hearted, and do a thousand things which make him, or them, the servant of all, besides taking observations, studying out routes, photographing, and enduring the hardships presented by circumstances. All this, without any authority inherent or delegated, and often in the face of adverse conditions, tries their patience to the utmost, and constitutes a task which no one who has not been placed in such a position has any idea of.

These difficulties are more accentuated in case of those who lead an expedition among the ice-clad peaks of the higher Himalaya, than of those who devote their attention to the lower, more or less inhabited regions, on account of the special hardships incident to life in the snow at high altitudes, and the absence of supplies of any kind, including wood, and, above a certain height, even water.

The explorer of Himalayan heights, besides possessing initiative, must be resourceful and have some inventive talent, for he is constantly called on to create something out of nothing, and to apply various implements to uses for which they were never intended. Finally, he must have the grit and perseverance to complete his toilsome preparations and undergo much trial and hardship, knowing that there are many chances against his efforts being crowned with success.
As we entered the Vale of Kashmir in the early days of May, 1902, we found it in one of those brilliant, blooming moods, that cause one for the moment to forgive the poets their gushing rhapsodies anent this much overrated valley. The Pir Panjal, in August as devoid of snow and as commonplace in contour as the walls of a second-class Tirolean valley, now rose from a bed of softest green, a shining white range feigning worthily eternal snows, which lost itself in the blue depths of a perfect sky.

Spring was flagrant in the "river'd meadowland," speaking from the budding hedgerows, flaunting multi-coloured wands of glory from peach, apple, cherry, and plum trees, and tingeing the lights and shadows, that moved over hill and dale, with the subtlest of Grecian blue.

The 4th May found us once more at Srinagar, with outfit and supplies, and arrangements practically completed for a second expedition to that part of the Karakoram or Mustagh range lying in the north of Baltistan. The Mustagh range has been popularly regarded as belonging to the Himalayan system, and is often mentioned as the "North-west Himalayas." Properly speaking, this is not the case, the Mustagh being a separate snowy range situated considerably north of the western end of the Himalayan, though connected with it by an intermediate mountain system. In the stricter sense, the term Himalaya is applicable only to the great snowy chain extending along the northern border of India and through Nepal, Sikhim, and Bhutan, beyond the Indus on the west, and the Brahmaputra on the east, and to the lower mountains and foothills running from it to the Indian plain. As, however, the conditions obtaining in the Mustagh and Himalayan regions are practically identical, we shall in this volume, in accordance with general custom, for convenience apply the term Himalayan to them both.

Our object on this occasion was to explore the great Chogo
Lungma glacier, which ends just above the village of Arandu, at the head of the Basha valley, in lat. 35° 52' N. and long. 75° 23' 40'' E. This glacier has a length of thirty miles, the upper half of which, together with over fifty miles of large branches, had never been visited by civilised man.

In 1862 Colonel Godwin Austin, while surveying for the Government of India, went up the nala in which it lies about twelve miles, but did not venture on the glacier itself. A few years later Frederick Drew followed the footsteps of Colonel Godwin Austin, and, getting upon the glacier, reached a point on it which, from his description, appears to have been about fifteen miles above its end, although he estimated it at twenty miles. Since that time sportsmen have occasionally ascended the nala for a few miles.

In the autumn of 1903, Major Max Schlagintweit published a statement in the "Mitteilungen," that his brother, Adolf Schlagintweit, was the first to explore the Chogo Lungma region in 1856. A careful examination of the writings of the brothers Schlagintweit in the library of the Royal Geographical Society in London and in the Königliche Bibliothek in Munich, as well as in the library of the D.O.A.V. in Munich, failed to discover any mention of the Chogo Lungma, or of Arandu, at its termination. Further, neither the Chogo Lungma nor Arandu is indicated on the maps which accompany the large work of the brothers Schlagintweit. Major Max Schlagintweit afterwards withdrew the statement, having found it to be erroneous.

To reach the district indicated it is necessary to go to Skardo, the chief town of Baltistan, and thence up the Shigar and Basha valleys. Of the two most direct routes to Skardo, the shorter, in twelve marches from Srinagar over the 12,000 to 13,000 feet high Deosai plains, was unavailable at this season on account of snow. This route is usually open only from the middle of July to the middle of September.
The longer, more disagreeable, but more convenient and generally used route, which is open the greater part of the year, leaves the Leh route a short distance beyond Kharbu, and passes down the Dras and Indus valleys to Skardo. From Srinagar to Skardo by this route there are eighteen and a half official marches, but the distance can be covered in twelve to fourteen days by making double marches. For details as to the length of the marches the reader is referred to the Kashmir Guide of Lieutenant-Colonel Duke, the much smaller one of Dr. Neve, and the Route Book by the late General De Bourbel.

The last of May, Dr. K. Oestreich, who was to act as topographer, arrived, and on 5th June Mattia Zurbriggen and Giuseppe Muller, who had been engaged as guide and porter for the mountain work. After consultation with Zurbriggen, we decided to send our supplies to Skardo by the Indus route, and
ourselves, although it was early in the season, cross the Alampi La, a snow pass north of the Deosai Plains, commanding a view of the Haramosh range, which we thought might offer a chance for an ascent later in the summer.

The Alampi path leaves the Gilgit road at a point a little more than half-way between the Burzil Chowki and Astor. The pass is not far from 16,000 feet high, and is said to be covered with snow at all times. It is a rough route, practicable only for coolies, who must be provided by the explorer with food carried by still other coolies.

Accordingly preparations were made to carry out this plan. A large quantity of rice was purchased, which, by the kind assistance of the late Major Bretherton, then in charge of the Gilgit Transport Department, was forwarded to Gurais, from which place coolies were to be taken. Major Bretherton supplied pony transport to Gurais.

Arrangements having been completed, the supplies and spare equipment were despatched via the Indus valley in charge of John Methuselah, a Madrasi well known in Kashmir, who understands managing natives better than any other Indian we have employed, and who performed this service to our satisfaction.

We were to start on 10th May. On 9th, we cycled from the hotel to our camp at Munshi Bagh to attend to some last details. As Mrs. Bullock Workman was dismounting on the grass her right foot turned on a small rolling stone, causing a severe and painful sprain of the ankle. This accident delayed our departure for a week, and caused a radical change in our plans. The Alampi route, with several days of rough walking and two of serious, rather steep snow-work, was not suited to a person with a sprained ankle.

It was therefore arranged, that Zurbriggen should follow the original plan and cross the Alampi La to the Indus valley, beyond which he was to penetrate the region lying under the
Haramosh range as far as possible, study the peaks, particularly Haramosh itself, and rejoin us at Skardo or in the Shigar valley.

On 12th May he set out, attended by a camp servant, and on the 16th we left Srinagar to go to Skardo by the Indus valley route, Mrs. Bullock Workman, who was unable to walk, being carried in a dandi by four kahars, and ponies furnishing transport for the remainder of the party and the luggage. At the Zoji La the tree-clad slopes of the Sind valley were left behind, and we descended the wet and disagreeable east side of the pass, still covered with snow, to the cheerless valley of the Dras and the brown, treeless plains of Ladakh.

At Dras the Kashmiri caravan was exchanged for one of Ladakhi ponies and pony-walas. On this occasion, as on the several others that we have travelled over this route, it was
a great relief to shake off the officious, noisy, garrulous, irritating Kashmiris, and take on the quieter, good-natured Ladakhis. The contrast was soothing, and we marched with lighter hearts and greater enjoyment of Nature around.

A few miles beyond Kharbu, which is a march beyond Dras, the Skardo path leaves the smooth, well-kept Leh route, and, passing over a stone-strewn plain, descends a steep and broken ancient moraine to a bridge, by which it crosses to the left bank of the Dras river, which it follows to the junction of that river with the Indus, and thence down the left bank of the Indus to Skardo.

From the point of its divergence to the left bank of the Dras river till it reaches Skardo, a much wilder region has to be traversed, and the marches are more arduous. Hardas, one march from Kharbu, is the last village where any transport ponies can be obtained, and here only a few, so that from here onward coolies have to be relied on for transport.

The Dras and Indus valleys are dreary and desert, being walled in on both sides by high mountain barriers of scarred and gullied clay, crumbling granite and shale, without vegetation, except here and there the aromatic shrub called burtsa, and wild rose trees, which will flourish where nothing else will grow, and which often bear such a profusion of blossoms as to hide their stems entirely from view. They flash up in the stony wilderness like marvellous colour-gems, each tree or group brilliant with every shade of mauve, from palest pearl to deepest crimson. They often grow luxuriantly among boulders where no soil is observable, or high up on the faces of perpendicular rock-precipices, the colourless surfaces of which they relieve in a most fascinating manner.

The path here is narrow and rough, running up and down steep, ragged inclines, across gorges swept by mountain torrents, through stretches of soft sand, and over narrow ledges projecting from perpendicular rock-walls, which overhang the
OASES IN INDUS VALLEY.

rushing rivers beneath. Every five or six miles, usually at the entrance of side valleys, the landscape is varied by oases perched on the mountain flanks, or nestling at the bottom of the valley by the river bank, beautiful in their bright spring green, or later, with their golden harvest, in striking contrast with the brown, barren surroundings. The eye, wearied with
the dull monotony of the chaos of rock and débris through which one has been passing, rests with delight on the terraced fields of waving grain bordered by a profusion of mulberry, apricot, pear, walnut, poplar, and willow trees.

In the centre of the oases stand villages of a size proportioned to each, by the industry of whose inhabitants these gardens in

![Image: Oasis in Indus Valley: Water-canal at upper edge coming from gorge.]

the desert are created. Every available bit of alluvium among the rocks is cultivated, and good-sized terraces bearing excellent crops are seen, the alluvium of which has been brought in baskets from wherever it could be found in the neighbouring wilderness.

These oases are of artificial creation. The land on a sloping surface is built up in terraces, one above another, retained by stone walls. A mountain torrent near by, which furnishes a
IRRIGATION OF OASES.

never-failing supply of water, is tapped at a point above, and a canal constructed from it to carry the water along the upper side of the land to be reclaimed. Openings are made in the canal-walls at desired points, and the water is distributed as required over the whole series of terraces from top to bottom. Separate canals are not provided for each terrace. The uppermost one is flooded with water to the top of its enclosing barriers, and the overflow from it floods the next lower one, and so on, till the whole oasis is irrigated.

The oases of these two valleys are typical of those which form the homes of the greater part of the population of Himalayan valleys. They depend for their existence entirely on irrigation. Were the artificial water-supply cut off, they would become as arid as the desert wastes around them. The semi-barbarous Himalayan valley-dwellers, who in their habits are but little above their domestic animals, are experts in the art of irrigation, and have nothing to learn in regard to it from Western civilisation. Their implements are simple, their methods of construction rude, but they apply the means at their disposal to the desired end in a manner absolutely scientific, and the results show their skill to the confines of the oases.

It is marvellous to see what crops are obtained from land that is often stony and sandy. Such luxuriant grain-fields we have seldom seen elsewhere. At first one is surprised at such results, when one considers that these lands have been constantly under cultivation probably for thousands of years, that the cultivators have not at their command manure and other fertilisers such as are used in Western lands, and that they harvest their grain by pulling it up by the roots, thus leaving nothing in the ground to nourish future crops.

A little observation reveals the secret of their success. The sediment brought down from the mountains in the water of the streams is a potent fertiliser, which is kept constantly applied
to the crops from the time they are planted till they are ripe for the harvest, so that the ground is continually enriched rather than exhausted.

As every part of the oasis is devoted to the cultivation of grain, with here and there a few vegetables, and as turf is only exceptionally seen, comfortable camping places are rare. Many a time we have been obliged to camp on loose sand, or in
WATER EROSION.

ploughed fields after the grain was harvested, or on ground wet from irrigation, or in the middle of villages on places used for the deposit of refuse, that were sometimes in a condition resembling ill-kept stable-yards. On this expedition the only available camping place at one village was a dilapidated, dust-covered burial-ground, where the tent-pegs found a precarious hold in the thin crust of earth covering the graves, into the hollows of which they penetrated. In Himalayan travel one becomes accustomed to almost anything.

Much, if not most, of the work in the fields is done by the women, who, although not fair to look upon, appear to be hardy and retain their activity and suppleness to a surprisingly advanced age. We have seen grey-haired, wrinkled women as nimbly as children after coolie trains leaving villages, to supply their equally grey-haired husbands with rations for the day's march.

The children, left to their own devices, learn at a very early age, like the young of animals, to take care of themselves and imitate their elders. At a village in the Dras valley, a child, not over two years old, was seen to shoulder deftly an infant of about four months and walk away with it.

One of the most interesting features of the Dras and Indus valleys is the evidence of water-erosion everywhere seen. Not only near the present level of the rivers, but at all elevations, even to the mountain-tops several thousand feet above, the granite rocks are smoothed, rounded, eroded in every conceivable manner, and dented with pot-holes, showing that at some distant period they were subjected to the action of moving water carrying stones. Boulders of various sizes are strewn about at all levels, honeycombed in a most remarkable way, some being mere shells, eroded both outside and inside.

From the shapes and positions of the pot-holes and erosions it is evident, that the direction of the currents that produced them was about the same as the flow of the two rivers at the
present time. The erosions are seen mostly on the left banks of these rivers, or west sides of the valleys, which slope away from the rivers much less precipitously than the right or east sides. The explanation of this, as well as of the question, whether the erosions were made at the levels where they now are by water flowing thousands of feet above the present rivers, or at or near the river levels and afterwards pushed up with the
mountain masses, we leave to those better equipped with geological knowledge than ourselves. Whatever may have been the conditions under which these effects were produced, it is certain that they existed very evenly over a large district.

At one of the Indus valley villages where transport coolies were changed, an instance of the demoralising effect of the contact of the modern civilised traveller with the untutored native presented itself. The lambardar brought to us a stupid-looking child, perhaps three years of age, who held out a folded paper for our inspection, which proved to be a chit written and signed by a member of an expedition to Baltistan, which had preceded us by a few weeks, stating that the child had lost its parents, that the writer considered him a very worthy child, that he had given him two rupees, and that he commended him to the charity of other travellers.

The question naturally arose in our minds, whether here was not a ruse to obtain money, similar to that often employed by coolies to escape further service, who in most out-of-the-way places would suddenly receive news of the death of a parent, usually their mother, which made their return imperative. In none of our expeditions did we ever lose a coolie by death, but their service with us was responsible for the death of a considerable number of mothers. In this case the bait was so unsuspiciously swallowed by our predecessor that encouragement was given to offer it again with his written endorsement, on the first opportunity, which happened to be afforded by our arrival.

Before leaving Srinagar, we received parwanahs from the English authorities and from the Maharaja of Kashmir requesting the head-men of Baltistan to give us all needed assistance as to transport and supplies. In addition to this, General Sir Amar Singh, brother of the Maharaja, and the late Captain Le Mesurier, British Joint-Commissioner for Ladakh and...
Baltistan, sent letters to the Tehsildar of Skardo directing him to ask his subordinates on our route to help us in every way.

As a result transport was promptly furnished, and we were everywhere met by the lambardars and the local Rajas, who made us such presents as lay at their command, viz., bouquets of flowers, baskets and large plates of mulberries, or, failing these in the higher villages, nuts and dried apricots. On our return journey in September, delicious fresh apricots took the place of the dried fruit, which, after our long sojourn in regions producing nothing but snow and ice, were much appreciated by all members of the expedition.

On reaching Tolti, a picturesque Indus valley village overhung by imposing rock-cliffs, the Raja, his brother, and attendants, accompanied by the Court-band, consisting of several musicians armed with tom-toms, cymbals, long shawms, and other wind instruments, came out to greet us. As we approached, the Raja stepped forward and grasped our hands with both of his, while the band saluted us with a tremendous chorus of, to our untutored sense, uncouth sounds, which, if volume was any criterion, testified to the cordiality of the welcome.

When we entered the village with the Raja, the chief men took the places of the hired coolies who were bearing the dandi of Mrs. Bullock Workman, and, a procession being formed, with the musicians at the head, we marched to the camping ground, a grass-covered meadow adjoining the polo field, bordering a rushing mountain-torrent, shaded by fruit-trees and flecked by great boulders fallen from the cliffs above.

We hailed this camping ground with delight, as it was the first really good one we had found since leaving Srinagar. We always prefer to camp near a noisy river or mountain-torrent, as it serves the double purpose of supplying water and of deadening the sound of the disagreeable voices of villagers, coolies, and camp servants.
EXCHANGE OF CIVILITIES.

When camp was established, the Raja, who had left, returned with his brother and suite, including that indispensable official,

the hookah-bearer, bringing as presents flowers, a sheep, and white and red cherries on large copper plates. After a further exchange of civilities, in the course of which we made him
presents in return, he arranged to supply us with provisions and coolies for the next day’s march and departed.

The following morning he appeared with thirty coolies, and himself accompanied us to Parkutta, the last village in his jurisdiction, fourteen miles distant, to see that we were properly provided for at that place. On the route he dismounted twice from his pony, and walked for some distance beside the dandi, chatting with the bearers like one of themselves. His advent among them created no stir, and no ceremony between him and them was apparent. Here seemed to be an example of a democratic autocracy. In crossing a torrent, which came down in several streams, he again dismounted and waded through the water, which was waist deep, holding one side of the dandi to steady it.

A larger band of musicians than that at Tolti received us on arrival at Parkutta, where, owing to the Raja’s orders sent on the previous evening, a fresh supply of coolies was awaiting us. At half past one p.m., after an hour’s rest, having taken leave of the friendly Raja and his suite, we started on our second march that day of twelve miles to the vigorous, but not harmonious, thunders of the village band.
CHAPTER II.


Skardo is situated in an amphitheatre among the mountains, at the point of entrance of the Shigar into the Indus river, and is surrounded by imposing peaks. It is the most important town in Baltistan, being the seat of residence of the Tehsildar, and possessing a post-office, telegraph office, sub-treasury, dispensary, and bazaar. The Government maintains a meteorological station, with mercurial barometer, thermometers, and other instruments, the readings of which at 8 o'clock a.m. are daily forwarded to the Meteorological Office at Calcutta. During both our expeditions to the Chogo Lungma and adjacent glaciers in 1902 and 1903, this served as our lower station for the calculation of altitudes, and we arranged with the Government official to keep a daily record of barometric and thermometric readings at 8 a.m., 12, and 4 p.m. for us, while we were away. This service he performed faithfully, and we were thus supplied with a complete table of readings for comparison with our own at all points reached during the expeditions.

On arrival at Skardo on 27th June, we found our man John, who knew how to make himself comfortable, snugly settled at the dak bungalow, the stone floor of his room well covered with durries borrowed of the Tehsildar. Our provision boxes, over which he kept jealous guard, were neatly arranged in rows in another room. For us, knowing we never used bungalows when we had our tents, he had secured a private bagh near by, shaded by apricot trees and enclosed by a stone wall, where we could
be safe from intrusion. In this camp was soon pitched. We remained at Skardo two days to perfect arrangements for the further journey.

Three weeks having now passed since Mrs. Bullock Workman had sprained her ankle, she decided to test its condition by attempting the ascent of the so-called Rock of Skardo, a rock elevation, the steep, verdureless, pathless slopes of which rise behind the town to a height of about 1,200 feet. Zurbriggen had not yet joined us, so she had to depend on the assistance of the porter Giuseppe, who had never before been on a pathless mountain.

They started at 7 a.m., intending to return by noon. They picked their way slowly up the sharp shoulder, now and again coming to large smooth slabs, which had to be traversed by such crevices as nature had rent in them, for no Society of Guides provides the rocks of Baltistan with convenient rope and iron aids for hands and feet. Near the top two chimneys nearly conquered them, as they had neglected to take a rope. With care these were finally surmounted, and at eleven o'clock the summit, a chaos of boulders, was reached.

The ankle had now become painful from the rough work to which it had been subjected, and it was evident, that the descent could not safely be made by the sheer route taken in the ascent. The porter was despatched to find an easier way down. He returned in half an hour with the information that he could find none.

Mrs. Bullock Workman thought there must be an easier way known to the natives, so she told the porter to return to camp as speedily as possible, report, and bring back a coolie who could guide her down. One water-flask being empty and the other only half-full of tea, and having but two biscuits, she reminded him not to forget to bring plenty of tea and some luncheon also. After objecting somewhat to leaving her
THE ROCK OF Skardo.
there alone for hours, the porter shouldered the empty flask and started down.

The noonday sun blazed fiercely upon the naked rocks, which had become so hot that the hand could scarcely bear to touch them. There was not a cloud in the sky to mitigate the fervour of its rays. The whole summit reflected the heat like a fiery furnace, which caused the skin of the climber to tingle and her head to become giddy. It seemed as if her mind were oozing away to join the heat waves that chased one another over the Skardo plain.

She sought a shady spot among the boulders, but they glistened with sunlight from top to bottom. After one o'clock one great boulder cast a small shadow on the burning surface at its base. Here she lay down with her head at least in the shade, and tried to sleep, but without success. Thirst became excessive. Every half-hour she indulged in two small swallows of warm tea from the small stock in the heated flask.

By three o'clock only half a cupful remained, so she refrained from further dissipation, and solaced herself with the thought of the three quarts she had ordered the porter to bring up. To pass away the time she made signals of distress to natives working in the fields below, but they did not see, or paid no heed, to her gestures.

About 4.30 p.m. she heard a shout, then a second. Her throat was so dry she could not answer. Standing up, she saw Giuseppe and a coolie scrambling up the wall. When they arrived, she seized a two-quart flask of tea and drank cup after cup until it was empty. Giuseppe looked at her in surprise, as if he thought she had lost her mind, but he had not been thirsting a whole day in a temperature of 90° in the shade and 160° in the sun. After a short lunch, the coolie leading the way, they started down.

They crossed to the rear of the peak, and descended on its
north side to the wide plateau. Before reaching easy slopes an old ruined fort clinging to a perpendicular scarp of rock had to be passed. Around the outside of the wall there was no foothold. The wall itself was in such a rotten, crumbling condition, that the coolie, who had the strength of a giant, was able to knock a hole through it at a favourable point. Through this he dropped about ten feet to a fairly substantial scree-slope, where he waited. Giuseppe's woollen putties were then tied securely together and used as a rope, held by which Mrs. Bullock Workman descended through the opening. The coolie, bracing himself on the shelving surface, supported first her feet emerging from a cloud of dust, and then her body, till she secured a firm footing. When a coolie undertakes to help a person in a precarious position, he may do so clumsily, but his hold is sure and his assistance efficient.

The remainder of the descent was made over scree and deep sand to a village on the Indus. Quenching their thirst here again, the party returned to Skardo after thirteen hours' absence. The experience was certainly an efficient test of the condition of the ankle, which the next day was no worse for the adventure.

On 30th June, having arranged with the Tehsildar all details for the supply of coolies and provisions, and with the postmaster to forward our mail by dak-coolies, whom we should send to him, we left Skardo for the further journey. A short distance above Skardo the Indus was crossed in a flat-boat to a large basin several miles in diameter, surrounded by mountains and deeply covered with sand. This basin had to be crossed in order to reach Shigar.

The wind-storms which rage here almost every afternoon have driven the sand into a series of remarkable sand-dunes. These take the shape of long, elevated ridges and hillocks, surmounted by sharp arêtes and curling crests, some of which strongly resemble snow-cornices. We could not perceive that
MT. KOSER GUNGE FROM SHIGAR VALLEY.
these actually overhung the perpendicular, though they probably do when formed in damp weather, the overhanging portions afterwards crumbling and falling when dried by the burning sun, for loose sand was seen on the leeward slopes just below the sharp edges.

The sand acts like snow under the influence of the wind, and the result here was an exact counterpart of a high snow-

region exposed to strong winds. The tops of the highest of these hillocks and ridges must have been three hundred feet or more above the general level of the basin. They were composed of fine white sand, while the lower slopes consisted of coarser sand driven into wavelets three or four inches deep, and from three to twelve feet in length.

The splintered rock-barrier forming the northern wall of this basin having been passed, the wide Shigar valley is entered,
with its constant succession of villages surrounded by fruit-trees and grain fields situated on fertile alluvial fans, which radiate from the openings of gorges cleaving the mountain-barriers on either side. The Shigar valley is renowned for the quality of its apricots and mulberries, which are delicious, as well as for the abundance of its grain. The village of Shigar is the principal grain-depot of this region.

In this valley the earliest glimmering of dawn was ushered in by a full chorus of bird-voices, great and small. Prominent among these were those of the sparrows, whose insistent twittering pierced the air in every direction with millions of fine needles of sound, that formed a setting for the more melodious notes of other species. By half-past five, when dawn had brightened into daylight, the chorus ceased, and only the music of scattered song-birds was heard.
The mountain-wall enclosing the Shigar valley on the east terminates at its northern end, at the juncture of the Braldoh and Shigar valleys, in a rock-peak called Buspar, formerly used by the Indian Survey as a trigonometrical station. Wishing to ascend this peak to obtain a view of the mountains on the north, we marched from Yuno, near the northern end of the Shigar valley, to the tiny village of Mango, situated a few hundred feet above the valley on the flank of Buspar, at an altitude of about 9,300 feet.

Mango, which has only a dozen houses, could furnish no supplies. Our servant John, or John Sirdar, as the natives called him, who had preceded us, had a terrace large enough for two tents banked up and levelled-off under a wide-spreading walnut tree. He also had a cow brought up to supply milk, and a sheep, fowls, and eggs, so that we were able to make a comfortable camp on the only level spot in the place. This served as our headquarters for several days.
Here, on 4th July, Zurbriggen rejoined us, having returned over the Ganto La from the region south of Haramosh. He reported the south side of that and the adjacent peaks to be rock-bound and very precipitous.

On 7th July, the weather being fine, we moved our camp up the steep stone and silt-covered slope of Buspar to a grassy maidan at the base of its rock-cone at an altitude of 13,800 feet.

The next morning, leaving camp at 7 o'clock, we climbed to the summit, 14,940 feet on the Survey map, 15,200 by our measurement, which was reached at 9.30, after some interesting rock-work. The last thousand feet consists of a mass of splintered granite blocks and boulders with grassy bits interspersed. The sharp summit is a pyramid of granite seamed with perpendicular fissures.

A grand view is obtained from this peak of the Shigar, Bralduh, and Basha valleys, and of the mountains beyond them. On this occasion it was marred by the presence of many clouds, especially concealing Ganchen and its neighbouring peaks, which more than any others we wished to study. After remaining three hours on the summit without obtaining a view of these last, we returned to camp, and the next day descended to Mango.
Crossing Bralidh River on Zak.
CHAPTER III.


The Shigar, like the Nubra river, consists of a network of rushing, mud-laden streams, which anastomose with one another throughout the whole extent of its broad valley-bed, enclosing islets of stones and sand brought down by floods from the mountains above.

It is formed by the union of the Braldoh and Basha rivers. The Braldoh, emerging from the Braldoh valley, divides, one large branch crossing the broad head of the Shigar valley to join the Basha river coming down on its western side, while another, sweeping around the base of Buspar, pursues its course along the eastern side, till it unites with other wandering branches below Yuno. The courses of the various streams are constantly changing.

There are no bridges in the Shigar valley, and the larger streams have to be crossed by means of a primitive, apparently frail, but really staunch craft, called a zak. This consists of pig or goat skins, usually twenty-four in number, inflated and attached by woollen cords to six or eight slender poles placed parallel to one another. The skins are so arranged that the legs project upwards, and they are inflated by blowing with the mouth into the open end of one of the legs, which is securely tied as soon as the skin is filled with air.

The zak is buoyant, and breasts the waves of the most turbulent streams in safety. It is managed by a crew of four men, armed with willow or poplar poles about eight feet long, with which they push it with considerable skill across the rapid
ICE-BOUND HEIGHTS OF THE MUSTAGH.

currents. It is so light that its crew can easily carry it to any desired point, and the skins can be deflated, detached from the poles, and packed for transport in a short time.

As it has no floor except the skeleton of poles, the passenger must be careful where he treads, or he will find himself stepping through into the water. He stoops so as to keep the centre of gravity low, balancing his feet on two poles, while he grasps two others with his hands. The water often splashes over the craft when well laden, wetting his feet to the ankles; but this is an incident he does not mind, so that he gets safely over the river. The embarkation is made at a point hundreds of feet above the landing-place on the other side to allow for the rapidity of the current, which carries the zak swiftly downward. As only five or six persons can be carried at one time, several hours are required to get a large caravan over a river.

Intending to cross the two main streams to the west side of the Shigar valley at a point opposite Mango, we sent an order to Shigar to have the zak ready at the appointed place early on the morning of the 9th. It did not, however, arrive until too late to get our large caravan over in time to reach a proper camping ground on that day.

We accordingly decided to go down to Yuno, where the river was less rapid and the crossing easier, to spend the night. The caravan was despatched on foot, while we, with the guide and porter, descended the river on the zak.

It is with something of a sensation, even when accustomed to the rough-and-ready vicissitudes of exploring life, that one finds oneself afloat on the troubled waters of a Himalayan mountain-torrent on such a frail bark, with only the thickness of a goatskin between one and destruction, borne irresistibly downward at the rate of fifteen miles an hour, dancing up and down on billows, of which Himalayan rivers can furnish tolerably good examples, whirling round and round in miniature maelstroms, in spite of frantic movements of the four poles in the hands of the
crew, shooting now to one side and then to the other, diving suddenly forward at redoubled speed as rapids are encountered, or scraping along the river-bed in shallow spots, with uncauny, grinding, creaking, tearing sounds unpleasantly suggestive of rents in the goat-skins, total collapse of the craft, and precipitation of its load into the seething waters around.
All this and more we experienced on that ride to Yuno. Twice we ran fast aground, and only got off into the stream again by dint of much pushing and hauling on the part of the crew, who jumped into the water to lighten the zak. Thanks to their zeal and skill, and to the fact that the stony pavement of the river-bed, having become smoothed by long attrition, caused the collapse of only one goat-skin, we escaped shipwreck, and reached Yuno long before the caravan, with wet feet, but otherwise none the worse for the perilous journey.

The next morning the zak was again brought into use to take the caravan over the large branch of the river directly beneath Yuno. We then marched two miles across an intervening, barren, rock-strewn tract, to a second large branch near the western side of the valley. Here another smaller zak, which
could only carry two persons at a time, was waiting. On this we crossed the second river, and, leaving the coolies to follow as fast as they could get over, made our way over sand and boulders to the path leading to the Basha valley.

Below Tisser this path winds up and down over the face of a rock-precipice overhanging the river, forming what in Switzerland would be called a "mauvais pas." Ascending the steep incline in a series of narrow steps, it descends again, passing over four perpendicular drops by means of ladders, and over two scaffolds, each formed by a long, slender tree-trunk supported only at the ends, directly overhanging the river at a distance of about three feet from the face of the precipice. We reached Tisser, at the entrance of the Basha valley, at 3 p.m., and camped in a clean, grassy meadow half a mile beyond it.

The Basha is one of the richest valleys we have seen in Himalaya. It is considerably narrower than the Shigar valley, and its general trend is about a thousand feet higher than corresponding parts of the latter. It has a large amount of arable land, which is extremely fertile, and cultivated to its utmost capacity. Enormous crops of wheat, rye, oats, buckwheat, millet, peas, maize, and other grains are raised, and the fruit-trees, including apple, pear, and walnut, which grow in profusion over its lower half, rival those of Shigar in size and productiveness. Both sides of the river are dotted with flourishing villages succeeding one another at short intervals.

Of these Doko, lying high, commanding a fine view of the valley to the south, and surrounded by imposing rock and snow-peaks, is the most picturesque. Its houses, like those of the other Basha villages, neither attractive nor interesting architecturally, are merely enclosures made of stones, wattles, and mud, with flat roofs, intended to shelter sheep, goats, pigs, and fowls, as well as human beings.

From Tandoro, a small oasis three hours' march above Doko,
we ascended a spur of Mount Sencho to a sloping plateau called Huldero, where we camped at an altitude of 13,500 feet. Directly opposite this spot above the east side of the valley towers the wild, snowy crest of Mt. Ganchen, 21,200 feet, the highest Basha peak, of which we had an unobstructed view, as well as of the somewhat lower snow-peak of Hikmul. The lower, rough rock-slopes of Ganchen fall precipitously to the Basha valley. They are practically unscalable. The main peak above can only be reached from the Basha valley through a steep, narrow nala, three miles to the north, running up behind the outer ramparts of the massif.

Ganchen is an interesting-looking mountain. As there were several days at our disposal before it was necessary to be on the Chogo Lungma, we decided that a closer reconnaissance might
be useful and instructive, should we care to attack this mountain at a later time. Accordingly, the next morning, descending again to the valley, and rejoining the main caravan, we crossed a jhula bridge spanning the Basha river, and soon reached Sesko, lying at the base of Ganchen on the east bank of the river.

Sesko is the largest of the Basha villages, and its lambardar is the highest official in the valley. The only place available for a camp was a small bagh in the centre of the village, the soil of which was boggy from the irrigation to which it had been treated a few days previously, and which had recently served as a pasturage for sheep. It was infested with flies and insects, that settled in myriads on one's face and even crawled into one's eyes. In one respect they resembled the mosquitos of the Deosai plains. At sunset they took flight, and ceased to make one's life miserable.

The lambardar supplied thirty-five coolies, who agreed to go to the high regions above and remain with us as long as they should be needed. Our servant John was ordered to remain at Sesko with the bulk of the luggage, to send us supplies and relays of coolies if required, and we left on 10th July to ascend the left bank of the river over the sloping tali to the nala seen from Huldero.

The lower end of this nala was occupied by an exceedingly steep fan, scored by numerous dry, stone-strewn water-courses, above which rose a high, still steeper, alluvial wall. After a fatiguing ascent of about two thousand feet, we reached at 2.30 p.m. the top of the wall, a bleak wind-swept ridge bounding a deep basin enclosed between it and two mountain flanks.

At this point we appeared to stand at the mouth of a cul de sac, which would put an end to further progress, but we discovered a narrow path leading around the basin on the precipitous left flank. We followed this for perhaps a mile, when it ended at the opening of an arid side-ravine, through which
coursed a foaming torrent issuing from the snout of a much-broken glacier.

We ascended this ravine, crossed the snout, and a short distance further on reached, at 4.30 p.m., a grass-covered alp rising at a sharp angle, on the top of which stood a dilapidated shepherd’s hut, occupied temporarily by three shepherds in charge of sheep brought up from below to this summer pasture. A shepherd in any country usually appears to be a person of low intelligence, but the Himalayan shepherd is the personification of primitive and unintelligent man, scarcely higher in his habits than the animals under his care. These shepherds were typical of their kind.

Having gone as far as was possible on this day, we looked around for a place to camp, but not a level spot large enough for even the smallest of our tents could be found. The only thing to do was, what we have often done under similar circumstances, to have the coolies excavate terraces in the hillside. Armed with our ice-axes and their own mountain-sticks, they set to work hacking and punching at the soil, which was well soaked by rain fallen the night before and during the day. When it was loosened, they used their hands as shovels to move it away and bank it up. In the course of the work two good-sized boulders were encountered, which, after the removal of the earth around them, were rolled away by the united efforts of all who could lay hands on them.

It is surprising how much can be accomplished without adequate tools when men really work with a will. By six o’clock two level terraces were completed, each large enough to hold a tent, but their surface was so muddy that they did not offer inviting resting-places. Fortunately the dry bed of a stream was discovered near by, covered with flat stones. The coolies were formed in line between this and the terraces, and the stones passed along from one to another till they were deposited on the terraces, which were soon paved.
COOLIES PASSING STONES FOR PAVING TENT-TERRACE,
Tents were pitched in the deepening twilight, and the necessary furniture moved into them by lantern-light. About 8.30 the khansamah served a meagre dinner, after which we went to bed with rain pattering on the canvas.

The next morning, leaving this place to its ooze and mud, we continued the ascent up steep, wearisome slopes of grass and rock, and finally over patches of névé, to an inclined plateau bordered by the first snow-fields of Ganchen. Here, at an
altitude of 15,096 feet, we established a camp, named Snow-line Camp, which was occupied for ten days. The place was not an agreeable one. The snow had only just melted, leaving the ground, scantily covered with the matted and bedraggled remains of last year’s grass, wet and cold. The new vegetation had not started.

A plan was adopted similar to that of the preceding day, and tent-terraces were built with stone slabs, which lay scattered about. These lifted us above the wet, but were not conducive to warmth, as the cold wind entered the tents freely through the crevices between the slabs, which it was impossible to close. Air circulating freely through the tents at temperatures never above 45° F. at noon, and often below the freezing point at night, made them anything but comfortable quarters. We suffered more from cold at this camp than at any other during the whole expedition, not even excepting snow-camps.

Our ordinary tents, supported by two poles and a cross-bar, were made without any openings, except in front, where they were closed with double flaps lapping over each other from either side. They were all lined with putto, or with soft cotton. They also had a border twelve inches wide around the whole lower edge, including the flaps, which, when turned in and weighted with stones or other heavy articles, effectually excluded the wind, when the tents stood on firm ground or on snow. In the present case this device was useless.

Tents thus arranged were perfectly comfortable with ground-sheets or durries, on glaciers or on snow, and, wherever they could be carried we preferred them to Mummery tents on account of their more convenient size. This class of tent we have found it advisable to have made in India, as being cheaper, lighter, and easier to handle than those made in Europe. A tent, eight by six by seven feet, with light bamboo poles, made of white American drilling, lined with soft cotton, can be got for about 2l. 10s., which will be water and wind proof, weighs
ASCENDING SNOW-FIELDS OF GANCHEM.
with poles only thirty-five pounds, and stands, with ordinary care, at least three seasons of constant use. If something more expensive be desired, khaki drill, or green jean, said to be water and rot proof, can be used, but these are somewhat heavier. We have found tents with side-walls more convenient than those running down in one slant to the ground, and also with the rear end rounded to offer less resistance to the wind.

For high snow-work we have used tents of the Mummery pattern modified to suit our needs. These have been from four to five feet high, made of green jean lined with grey flannel, with ground-sheets sewn in, with side-walls twenty inches high and double flaps, spanned over two light bamboo poles by end cords and by three cords on each side. We tried a regulation, unlined, Willesden-canvas Whymper tent during our first Himalayan season, but soon discarded it as being too heavy, too difficult to set up, too cold, and of inconvenient shape. In using a tent with ground-sheet sewn in, on an exposed mountain-side, one feels a bit nervous in regard to the impossibility of escape, should the tent be carried away by wind and hurled into depths below. The fastenings of such a tent should always be well secured. With larger tents a double fly may afford some protection from the heat of the sun, but its efficiency in this regard is slight, and, where transport facilities are slender, it is a luxury that may well be dispensed with. Silk tents, which have the advantage of being light, are not sufficiently warm and substantial for the conditions existing in high Himalaya.

Before the tents were fully pitched a snow-storm broke upon us, and, for the next three days, the sky was heavily obscured and snow was falling most of the time, which prevented any outside work, and kept us shivering under shelter. The camp was a good distance above tree-growth, and the only fuel available was short, scrubby brushwood, mostly sappy, and all of it
so wet as to be useless. Part of the coolies were, therefore, sent down the mountain daily to fetch wood.

The fourth day being fine, advantage was taken of the sunshine to visit the snow-fields above the camp to look about and photograph. Mrs. Bullock Workman and Zurbriggen ascended a rock and snow-summit of 16,500 feet, which was named Practise Peak. The snow had softened on the return so that we sank into it to the knees at every step.

On 21st July, at 6.45 a.m., we left Snow-line Camp, with thirty coolies, to make a reconnaissance of the snow-region leading up
to Ganchen, and, so far as possible, of that peak itself. We ascended several long snow-slopes and shoulders, reaching in two hours a large, gently inclined, but considerably crevassed snow-field lying between Ganchen and its sister-peak Hikmul. No great difficulty was experienced in crossing this. Leaving Hikmul on the left, we made directly for Ganchen, which seemed to rise from its eastern end.

This proved not to be the case, for when, early in the afternoon, we reached a long, curving, snow-ridge, ending above in a broken, jagged, rock-arête covered with granite slabs, some of which projected from its edge, we found this marked the rim of a large snow-basin several hundred feet deep, the walls of which dropped perpendicularly from the arête, and fell away in a slant of 60° from the snow-ridge. Bordering the edge of the ridge near the arête was a depression, where we camped in soft snow (Camp Ganchen) at an altitude of 17,217 feet.

From the depths of the basin and forming its wall on the other side, shot up the snowy main peak of Ganchen, in a series of castellated ice-precipices, terraced one above another, tremendously massive, yet gracefully ethereal and apparently inaccessible, as it stood silhouetted in wondrous majesty against the cloudless sky.

Were an ascent to be attempted from the side where we were, it would be necessary to descend the sharp snow-slant to the bottom of the basin and scale the glittering, broken wall for two or three thousand feet to a break, where two or three Mummery tents might be placed. From here, up steep inclines of rock and snow to a lower bosse-like summit, and then over easier slopes to the final peak, an alluring snow-cone.

A band of trained mountaineers might, perhaps, be able to accomplish this, but it would be a difficult task, which, certainly, could not be done with coolies. As in cases of some other snow-mountains, the intermediate portion between Camp Ganchen and the spot where a final bivouac
might be made would be by far the most difficult part of the ascent.

After our tents had been pitched, the coolies, disdaining to use their tent, betook themselves to the shelves and recesses of the arête, now well warmed by the sun, where they seemed as much at home as a troop of monkeys, roosting in the most unceremonious manner upon projecting slabs, in positions the mere sight of which made one shudder. Tea and tobacco were served out to them, of which luxuries they eagerly availed themselves.

The next morning when they were called they did not respond readily, which excited our suspicions as to their intentions. After a while two-thirds of them came out of their lodging-place, and took a direction which would lead them down the mountain rather than to our camp. We headed them off on the only path they could escape by, and soon persuaded them to go to their loads. Zurbriggen now went up to the arête and found ten more hiding among the rocks. Four of these fled while we were busy with the main body, and made for the lower camp without waiting to learn where we intended to go on that day, bearing with them the rations of their compatriots. Had we proposed to move higher up, the attempt would have been in vain, as not a coolie would have gone a step further.

As if in accord with the mood of the coolies the brilliant weather of the previous day changed, and by 7 a.m., as we started downward, the sky became heavily overcast, all signs indicating an approaching storm. We returned to Snow-line Camp, to be housed again by driving snow.

About a mile north of Snow-line Camp a heavily seamed and broken glacier, somewhat more than half a mile wide, sweeps down from the icy side of Hikmul towards the Basha valley. On the northern bank of this glacier and rising up sharply above it is a mountain-spur terminating above in several pointed
rock-peaks. We decided to attempt the highest of these, and accordingly left camp at 7 a.m. with guide, porter, and one instrument-coolie. Our enjoyment of this, as of all special mountain and glacial work, was much enhanced by the fact that we were free from the droning band of luggage-coolies, whose presence was always a threat to the success of a day’s expedition.

We ascended over the snow-fields above the camp and then descended to the glacier, through the intricacies of which a way was found. At ten o’clock the base of the highest peak on its further bank was reached. The peak towered some two thousand feet directly above the glacier. This, like others in the region, is composed of granite, its side rising at angles of 45° to 60°, being much broken and covered with boulders, slabs, and splintered fragments, which rendered the ascent arduous, footholds in places being difficult to find. Here and there large loose stones had to be dislodged from our path, which started stone avalanches, that crashed downward to the glacier.

At mid-day a short col, connecting the two narrow wedges which formed the main and lower summits, was reached, where we took tiffin. Warily traversing this col we attacked the face of the highest wedge, composed of a series of narrow and steep but substantial ledges. Just below the top two formidable gendarmes were propitiated, and at two o’clock we stood on the top at an altitude of 17,600 feet, or rather took turns in standing there, as it was a knife-edge, falling away in precipices on three sides, where there was room for only two persons at a time.

The downward view to the north was startling. A clean sweep of fifteen hundred feet of black rock ended in a wide bergschrund followed by a long snow-slant that would greet a climber with defiance. On the west, beneath us, rose a series of rock-needles, which looked ready to impale anything that might fall from where we stood. Toward the south, Mustagh
grape - ICE-Bound Heights of the Mustagh.

giants loomed impressively. On the east, dark thunder-clouds were rolling towards us from Ganchen, so, after exposing a few plates, taking readings, and leaving our names in a glass jar, serious attention had to be given to the descent.

Progress was slow, and, before the narrow col was reached, peal after peal of thunder reverberated among the peaks, and a heavy shower of rain and hail beat down, wetting us to the skin. Few things are more trying to the mountaineer than the descent from a steep rock-summit in a thunder-storm. There is imperative necessity for haste and equally for the utmost caution; consequently the dilemma is obvious. This was the severest thunder-storm we had met with during four seasons in Himalaya, where they are rare.

By the time the glacier was reached we all needed a short rest to restore our strained nerves. The storm had passed, but the jagged glacier, left by it slippery and in its worst condition, now remained to be passed. By the exercise of care and patience this was effected, and we arrived at camp after a fourteen hours' absence. The conquered peak was named Mt. Rachel.

The subject of rock-climbing at over 18,000 feet does not appear to have been discussed by the few alpinists who have visited the Asiatic mountains. As our lantern views of the magnificent, many times magnified, Grepons and Cervins of Himalaya have been thrown on the screen in various parts of the world, alpinists present have remarked, "What wonderful mountains! What aiguilles! If these are climbable, what opportunities for rock-work the Karakoram offers!" "Yes," we answer, "if climbable": for rock-gymnastics on the great castellated granite-massifs and cathedral-spires rising along the course of the Biaso, Chogo Lungma, Hoh Lumba, and other glaciers, to a height of 20,000 to 23,000 feet, present quite a different kind of task from those offered by Swiss mountains.

A rock-face of five hundred feet in the latter assumes a proportion of two thousand feet on an Asiatic colossus; a gendarme
MT. RACHEL, 17,600 FEET, TELEPHOTO FROM ARANDU TWELVE MILES DISTANT.
of fifty feet that of five hundred; and a chimney, in its formation, perhaps, no worse than a Swiss one, becomes formidable on account of its height, so that an ascent that on a smaller scale

and at a lower altitude might be easily handled by an expert climber, would, on a peak of 20,000 feet, become an exhausting and impossible grind.

To these difficulties must be added the rapid and extensive

ON SUMMIT OF MT. RACHEL, 17,600 FEET, BASHA VALLEY.

M.
weathering of the exposed rocks, rendering them rotten and dangerous; the verglas, which may quickly disappear in mid-summer on peaks like the Dent Blanch, but clings more persistently to the surface of the storm-tortured Himalayas; and the rarefaction of the air at great altitudes, which, however well a person may endure its effects, makes measured movement and frequent halts for breath a necessity. In difficult situations the breath could not be held long enough to make the exertion required to overcome an obstruction, nor would it suffice to support a series of quick movements which might have to be made.
LAMBARDAR OF ARANDU AND WIFE.
CHAPTER IV.

At Arandu—Selecting Coolies—Arandu Lambardar—Arandu Women—Start for the Chogo Lungma—Glacier and Mountains—Life at Riffel Camp—Paying Coolies—Outlook from Riffelhorn.

Fearing, if we remained longer, that the jarring elements might interfere with the main work of the summer, we beat a retreat from the fascinating Basha uplands, and went to Arandu (9,519 feet), the last and highest village in the valley, a compact nest of houses nestling in the midst of cultivated fields, a final dot of irrigation-nurtured green poised between the converging tongues of the Tippur and Chogo Lungma glaciers.

We headed a long, though it could not be said merry, band of coolies and chief men, as we passed through the village on 25th July in a drenching rain on the way to a small, grassy, willow-shaded bagh, some seventy-five feet higher up on the slope. The rain-soaked grass and grain overhanging the narrow path waist-high creaked as we plunged through, deluging our limbs and feet with a continuous shower.

The villagers offered us a hut as a protection against the inclement weather, but we declined the offer, preferring a camp on the wet grass of the bagh to the risks involved in exposing ourselves to the nameless discomforts of a native habitation.

Besides two Wasirs, or head-men, from Shigar, who came with us, a Government chaprassi, and several Basha lambardars met us at Arandu. While the weather was righting itself, we spent a day selecting coolies from a large number collected for our inspection. Although there was little choice, we picked out the strongest, best clothed, and least stupid-looking of the motley crowd, rejecting those who had no woollen clothing, as well as several affected with diseases of the eyes and skin. On account
of the nature of the service required of them the question of clothing was a matter the importance of which neither coolies nor lambardars seemed able to grasp. On more than one occasion, later on, coolies, that were sent to replace those who had given out, presented themselves in the snows far up the glacier clothed only in a cotton shirt, their legs being bare. They were, of course, of no value to us, and after being fed were sent back as soon as possible.

It was desirable to take one of the Basha lambardars with us in charge of the coolies, to keep them in order and distribute their food, which was provided by us at considerable trouble and cost. The only one of the lambardars who had sufficient backbone to be willing to undertake this service was the lambardar of Arandu. The others, as we afterwards learned to our cost, were a craven, worthless lot, who, having promised to render all possible assistance, could not be depended on even to furnish the supplies for which they were paid.

The Arandu lambardar accompanied us both in 1902 and 1903. He was a pretty fair mountaineer and by no means a coward. There was something in him to which one could appeal, which is more than can be said of many of his race. His moral code was not modelled after the strictest Christian ideals, but the results of its practical application were not very different from what one sees in Christian lands.

Though we never felt sure of his loyalty, through a judicious mixture of coaxing, threatening, and promises of a good bakhshish, he was induced to remain tolerably faithful to us, and proved really useful in keeping the coolies up to their work. In comparison with the nine other Basha lambardars we came to regard him almost as a friend and as a pattern of Balti morality. When the cowardice and moral obliquity of the rest are considered, his shortcoming must be regarded with leniency.

Arandu is a small village, having at that time only thirty
coolies. Twenty of these were enrolled among our force for this expedition, and later all of them were in our service. They were the best clothed, and proved themselves the most active and reliable of the Basha coolies, standing by us on two occasions when others deserted.

While we were at Arandu, at different times, the chief women of the village paid visits to our camp, bringing offerings of rancid walnuts and dried apricots. They had on all their finery, which consisted chiefly of bead-necklaces and circular flattened metal-discs worn on the breast. Just beneath these bunches of keys were suspended by thongs from their garments. These were not the keys of chests containing evening gowns and
jewel-boxes, but they opened the doors of pig-sties, chicken-coops, and sheep-pens. They were not worn for ornament only, but also for security when the owner went abroad, lest some friend might effect an entrance and carry off a sheep worth a rupee.

The wealth and importance of the owner were also indicated by the number of keys carried. The lambardar's wife had four bunches, and the two women next in importance three. These women, like those of Ladakh, give special attention to dressing their hair, which hangs in many small braids from the side and back of the head, reinforced by a generous quantity of dark wool, to below the waist, where it is gathered into one plait, which, reaching nearly to the ankles, ends in small tufts or tassels. This arrangement is so elaborate and requires so much time to complete that it is said to be renewed only a few times in a year.

On the morning of the 28th July our caravan, consisting of ourselves, guide, porter, fifty-five coolies, fifteen goats and twelve sheep, left Arandu to ascend the glacier. The sheep were taken for food, to be killed as needed, the goats to supply fresh milk for the guide and porter. The Himalayan goat is a smaller, more graceful animal than the European, its odour is far less strong, and its milk more palatable. We never used the last ourselves, preferring condensed milk, but the guides liked it and had great faith in it as an article of diet. At all camps below the snow-line the sheep and goats were able to find plenty of food among the various forms of vegetation.

The lambardar said he had been up the nala along the side of the glacier for about two marches. Beyond that distance he knew nothing of it. The start was delayed an hour by the necessity of hunting out a number of unwilling coolies who had hidden themselves.

We crossed the dirty tongue of the glacier, here about a mile wide, to the left bank, and ascended for eight hours in the
moraine-strewn space between the glacier and the mountains left by the recession of the ice, when we came to a narrow, torrent-washed, side-nala, about eight miles above Arandu.

The only level spot in this nala was a small sandy maidan just at its mouth, which was occupied by a sportsman, who had preceded us by a few days from Arandu. He was the last European we saw in ten weeks.

The remaining surface of the nala was uneven and covered
with débris and rocks washed down from above, among which flourished a strong growth of willows, poplars, and the aromatic burtsa. After some search a reasonably flat place was found, about which, after some clearing away of stones and bushes, tents could be scattered. This was named Burtsa Camp. Its altitude was 11,500 feet.

We were detained here three days by bad weather. On the first of these, to occupy the coolies, the lamberdar and thirty of them were sent further up the side of the glacier to collect all the wood they might find for future use. Judging from European standards, one would say that thirty men could cut and gather enough wood in a day to keep us in fuel for some time. Towards midday, strolling out ourselves for exercise, we came on the whole company, about two miles above camp, sitting idle on the hillside, not having cut a single stick. We set them at work immediately, and the following day sent the porter out with them with instructions to see that they accomplished what they were ordered to do.

After Burtsa Camp was left the path became rougher, the glacial walls and lateral moraines higher, rising above the line of march by seventy-five to one hundred and fifty feet, so that for long distances we could not see the upper surface of the ice. At 5.30 p.m. we camped on a sandy maidan covered at one end with a scanty growth of grass. Between Burtsa Camp and this camp the hillsides for several hundred feet above the glacier were dotted with cedars of moderate size, standing singly or in groups of two and three. Many of these were shattered by lightning or storms. Even below Burtsa Camp the quantity of wood growth was scarcely greater, and of forest, as ordinarily understood, there was none.

On this day's march we passed a number of prostrate cedar trunks much larger than any of those now standing, which, though they had evidently been lying for many years, were still sound. The positions of these were noted, as from them our
ASCENDING SECOND SECTION OF CHOGO LUNGMA. LARGE MORaine BEHind FIGureS IS IN CENTRE OF GLACiER.
season's fuel-supply would have to be obtained. Both these and the growing cedars ceased at about the place where this camp was placed, so we named this Last Wood Camp. Its altitude was 12,679 feet. From here the upper part of the great ice-river comes into full view, its white surface banded with dark moraines, running many miles to the west, becoming more arctic in character as it rises among the towering snow-peaks in which it takes its origin.

Leaving Last Wood Camp on 4th August we traversed a stretch of rough moraine falling from the tongue of a large receding branch-glacier, which no longer reached the Chogo Lungma, climbed several hundred feet over a mountain shoulder to avoid passing under a dangerous, perpendicular, stone-packed clay-cliff, and then took to the glacier itself a short distance below the Bolucho branch.

Getting on the glacier was not so easy as it might appear, for the ice for a quarter of a mile from the bank was broken into huge, irregular masses separated by wide crevasses unspanned by snow-bridges. We led the caravan in a serpentine course through these to the middle portion of the glacier, which, though striated by giant medial moraines and elevated ridges intersected by large crevasses, afforded a safer path, which was followed upward in the glacial axis. In this white wilderness, now visited by man for the first time, squads of coolies could be seen throughout the day resting or plodding along with tents, bags, and boxes.

As we advanced, of a sudden, we would be brought up standing on the brink of a deep, blue ice-chasm, at the bottom of which, to judge from the roar, a hundred ice-blocked streams were meeting in anger. How graphically the word moulin describes this phase of glacial life and energy. It is not the mill of enterprise grinding away for human progress, but the mill of Nature sounding tirelessly by day and night, helping to bring about manifold changes of advance and recession, turning into
crevasses and splitting into séracs the apparently inert but really ever-changing glacial mass.

The Chogo Lungma, which widens as it ascends, here attains a width of over two miles. Twenty miles above the tongue it makes a bend to the south-west, forming a large basin, into which projects a rock-promontory, the end of a spur sent down by a cluster of mighty serrated peaks piled over one another in chaotic grandeur, and rising above the glacier with spectacular effect. The highest of these is a beautiful snow-needle, towering nine thousand feet above the glacier, fixed from afar by the Indian Survey at 22,810 feet, and known on its records as Indus Nagar Watershed Peak, No. 4. This is one of the personalities of the Chogo Lungma, being with one exception the most prominent landmark, visible from most points on its upper half and upper branches, as well as from heights from a long distance.

One might imagine the great ice-stream, which to this point, though receiving several tributaries, sweeps upward with unbroken contour, to be cleft in two by this rugged wedge thrown out by these monarchs of rock and snow, for here it divides into two arms, one of which, turning to the right, ascends north-west as the prolongation of the glacier, while the second runs south-west to the north wall of Mt. Haramosh.

The end of the promontory, where it falls away to the glacier, was free from snow and clothed with grass and low bushes. These circumstances, together with its central position, rendered it the most desirable, and indeed the only suitable, place in the region for the base-camp. The pressure caused by the meeting of the two glacial arms off its point had broken up the ice and raised it in a fringe of huge séracs, separated by deep crevasses, which barred the approach on both sides. The guides were occupied for two hours in cutting a passage through this barrier, so that coolies and animals could pass.

When all were safely landed, we established our camp, on
the afternoon of 4th August, on the slope about a hundred feet above the glacier, at an altitude of 14,067 feet, building out terraces for the tents to stand on. This was named Riffel Camp. It served as our base for a month, and from it all our explorations of this neighbourhood were conducted.

Here all supplies and outfit were collected. Here the coolies built huts for themselves in the crannies of the rocks with slate slabs, which covered the ledges, and a busy village soon sprang up on a spot never before trodden by the foot of man. Gangs of coolies were sent down to the hillsides below to cut and bring up firewood, and to fetch provisions for us and themselves from Arandu, where they were delivered from the other villages. Here also our mail was brought by dak or post-coolies in our employ, who were kept constantly on the route between the camp and Skardo, the last post-village seven marches distant.

Here we experienced various phases of mountain-life, shivering through days of pelting snow-storm, basking on the slope when the sun shone, resting after arduous glacial and mountain work, and, taking the bitter with the sweet, living a glorious untrammeled mountain-existence, to be found nowadays only in the unexplored corners of the world.

The goats and sheep seemed to regard the place as their natural habitat. By day they roamed at will over the grassy slopes under the watchful eye of a goatherd, and at nightfall, or in bad weather, retreated to shelters built for them by the coolies. They were happy enough except when, as happened once or twice, so much snow fell that they could not burrow through it to get a nibble at the grass beneath.

Time at this camp never hung heavy on our hands, even when we were storm-bound, as was the case for days together; for there was always plenty of work to be done in taking observations, writing up notes, developing negatives, making repairs and preparations for further movements, and looking after the thousand and one matters that pertain to the
organisation of a mountaineering and exploring expedition that employed from eighty to one hundred coolies.

The coolies sent down the glacier for provisions and wood soon learned to find their way alone through the jagged séracs, which, encircling our airy perch with a barrier of ice instead of fire, converted it into a kind of Brunnhildaberg that we were the first to storm. In spite of repeated warnings, however, they persisted in using as a passage from the séracs to the smooth ice below, a deep furrow formed at the line of junction of the two glaciers, which, though the shortest and easiest route, was exposed to danger from falling stones.

One day, as a number of coolies laden with wood were coming through this furrow, a large stone loosened by the sun's heat...
INDUS NAGAR WATERSHED PEAK NO. 4, 22,810 FEET. A MILE IN FRONT CATHEDRAL PEAK. (TELEPHOTO.)
SUMMIT OF KIFFELHORN, 15,337 FEET, WITH CAIRN.
fell from the ice fifty feet above, striking one of them on the hip and knocking him senseless. There was a great outcry among his companions and an uproar in the camp, as the lambardar and numerous coolies rushed down to the aid of their injured comrade. They brought him up, his head, arms, and legs each supported by a coolie, singing a dismal chant as they came. The khansamah said it was a death-song, for they thought he was dead.

When they arrived he was unconscious, and his extremities were cold, though no bones were fractured, and, in spite of blankets and such measures as could be taken, he remained in this condition till the next morning, when coolies were detailed to take him down to Arandu. We never learned whether he recovered or died. He was the only coolie injured while with us on any of our expeditions.

At this, as at other camps, coolies often came to us complaining of illness and asking to be discharged. They were carefully examined, and if found to have fever, gastric disturbance, or other symptoms of illness, were paid off and permitted to depart. Otherwise they were told there was nothing the matter with them. It was seldom they feigned illness a second time.

Pay-days at this camp were busy days. A list was kept of the names of each coolie, of his father, and of the village from which he came, to distinguish him from others bearing the same name, the variety of names not being great. Also the date when his service began and on which he was last paid. The coolies were all ranged in line by the lambardar, who brought them up one by one. The amount due to each was given to the lambardar, who counted it and handed it to the coolie in our presence. This furnished a guarantee that the coolie was paid. His name being checked, the next was brought up. At the time of payment the lambardar gave the coolies the whole amount paid, deducting nothing for himself. Whether he afterwards collected his dastur from them, we did not learn. When sixty to eighty
coolies were to be paid, considerable time had to be devoted to the process.

The weather here was cool and often stormy. The temperature during August at 6 a.m. ranged from 27° to 37° F., and at noon from 47° to 55° F. in the shade. It was seldom that a sun temperature at noon could be taken on account of clouds, but on one of the few occasions when this was possible the black-bulb thermometer registered 163° F. The next year the sun temperatures greatly exceeded this figure. The lowest minimum at night was 20° F. As the camp was surrounded on all sides by ice and snow, the wind was cool, from whichever direction it blew, which made al fresco meals out of the question, but occasionally we were able to take tiffin in the open.

From the promontory two sharp rock summits rise, one of which, directly above our camp, so strongly resembles the Riffelhorn at Zermatt as seen from the Gorner glacier, that we christened it the Asiatic Riffelhorn. Although a pigmy in comparison with the peaks around it, it is a giant as compared with the Zermatt peak, having an altitude of 15,337 feet to the latter’s 9,617. It is peculiar in that a wide band of black slate is superimposed from bottom to top on the grey granite of which it mainly consists.

The morning after arrival at Riffel Camp being pleasant, we ascended the Riffelhorn with guide, porter, and a coolie to carry instruments. This gave us a stimulating rock-climb varied by a chimney a short distance below the top. The top is small, having only room for four persons to rest comfortably on at the same time; but from its position, standing out like a sentinel in the centre of the vast amphitheatre of the upper Chogo Lungma, it commands a scene of unrivalled glory. From it were revealed to us in a moment the trackless ice-fields and peerless summits among which we were to live and sleep for several weeks.

Directly beneath us the steep, mottled, grey-and-black wall we had just ascended fell away to the sloping plateau dotted
GLACIER AND LAKE.

with tents, coolie and sheep huts. Beyond this the great seamed and riven glacier, its surface like a frozen white-capped stretch of ocean, descended to the east for twenty miles until lost to view among an infinitude of peaks, and rose sharply on the west nine miles to its snowy source at 20,000 feet, bordered on both sides by peaks of varied outline towering from 22,000 to nearly 25,000 feet, a veritable stairway of the gods.

Opposite Riffel promontory in the middle of the broad expanse nestles in icy setting an exquisite lake, reflecting like a crystal not only the deep blue of the sky but also the bold needles of the peaks beyond. To the south-west the full course of a splendid crevassed glacier catches the eye, running straight away eleven and a half miles to the base of Mt. Haramosh, which, like a white eagle with spread wings, hovers over a weird glittering world of rare beauty.

Such a point for observation and photography is rarely found. We returned to it several times to study the topography of the region, and the moods of the mountains so varied and so almost human under the quickly-changing aspects of a Himalayan summer sky. We built a stone-cairn on the top, which can be seen for a long distance, in which notes of the summer's work were left, and later of a traverse of this peak.
CHAPTER V.


After affairs at Riffel Camp had been put in working order, leaving the lombardar and all weak and insufficiently clothed coolies behind, we set out with fifty-five of the strongest, carrying camp-outfit, provisions, and wood, to explore the upper part of the Chogo Lungma, which stretches away nine miles to the base of the snow-wall in which it takes its origin.

For a mile above Riffel promontory the glacier is broken into great séracs separated by wide and deep crevasses. We had to pass through the labyrinth formed by these, and, as no investigation of its mazes had been made before starting, considerable time was spent in finding a route adapted to the mountaineering powers of the coolies, and cutting steps up and down the ice-slants.

We went ahead with the guide and porter, roped, the coolies following well enough with some assistance at difficult points, till we came to a large sérac cut off from the glacier above by wide crevasses, which barred further progress in that direction. The caravan was halted and the four Europeans went ahead to seek an outlet.

After a time, as none was apparent and there were signs of uneasiness among the coolies, we unroped and returned to them, leaving Zurbriggen and the porter to continue the search. In difficult positions it is fatal to give coolies much time to reflect. Every band of them includes a glib-tongued individual possessed of oratorical powers, who is sure to seize the opportunity to set
INDUS NAGAR WATERSHED PEAK NO. 4, 22,810 FEET, NORTH FACE. CHOGO LUNGMA WITH SÉRACS IN FOREGROUND.
them all by the ears. It was so in this instance. By the time we reached them the orator had wrought them into a panic, not one man being open to reason.

Had the moment not been a critical one—for had we yielded then, there would have been an end of glacial investigation—the scene would have been most amusing. The howling mass of humanity, some with loads, some without, were jumping about, gesticulating, pointing to their feet and up and down the glacier, while several entirely beside themselves were sprawling like frightened beetles prone upon the ice, frantically clawing it with hands and feet. The khansamah and a village head-man were showing their contempt of these last by belabouring them vigorously with their bergstocks, which castigation had the effect to partially recall them to their senses.

As a last resort the ringleader made a fervid appeal to the Memsahib, begging her to return. He had no suspicion that she was the most obdurate person in the party, so far as returning was concerned. Zurbriggen now appeared and reported he had found an easy exit near at hand.

Finally, through the united efforts of the Sahib, khansamah, and village head-man, order was restored, and the coolies, shouldering their loads slowly followed the guide, the orator, under the supervision of the Sahib, heading the line.

The sérac-belt was succeeded by about two miles of fairly smooth ice, after which came a terraced ice-fall extending across the glacier. Having partly ascended this, we followed the terraces over to the north bank, where quite a large spot on the mountain-flank was free from snow, the last bare spot found. This was reached early in the afternoon. Here we decided to make a secondary base-camp for the work higher up, which would also serve as a camp of refuge in case we were driven down by storms.

It could not be called an ideal camping ground, being so slanting that luggage and boxes had to be propped up with M.
stones when placed on the ground, to prevent them from rolling
down the mountain-side. It took three hours for the coolies
under our supervision to dig away the soil and build terraces for
the tents.

The situation was magnificent. Above the camp precipices
and snow-slopes towered towards the sky. At our feet lay the
glacier broken into thousands of pinnacles, which swept upward
for a long distance in a broken and confused mass. Across the
glacier immense snow-peaks shot up like ghostly sentinels.
One of the most singular and beautiful of these was a sharp thin
crest, rising in the centre to a point, the whole sky-line of which
was fringed with snow-cornices, from projecting points of which
rock-ribs ran down over its steep, broad, snow-covered face, the
spaces between them being gullied in a hundred places by
avalanches, giving the whole a peculiar channelled appearance,
from which we named it the Furrowed Peak.

Peaks of this order, surmounted by overhanging cornices,
which send down frequent volleys of avalanches to score their
snow-walls, we have seen only in the Karakoram, where a number
have been met with.

This camp, the altitude of which was 15,096 feet, was named
Sérac Camp. We built a substantial stone cairn two hundred
feet above it on a projecting point, in which was placed a record
of the interesting explorations made from this camp.

The next day we ascended a snow-summit rising from the
wall above the camp. The first 2,400 feet gave us more hard
grinding work than we remember to have had on any peak of
similar height. We had to encounter, not an interesting rock
face, but a succession of rotten rocks interspersed with broken
shale and scree-covered slants rising at angles, as shown by
clinometer, of upwards of 50°, the ascent of which was very
fatiguing. After a four-hours' scramble up this part, the base
of a very steep snow-wall, about three hundred feet high, was
reached, which, happily for us, was still at eleven a.m. in a
FURROWED PEAK WITH CORNICED SKYLINE, UPPER CHOZO LUNGMA
(TELEPHOTO.)

H 2
condition for step-cutting. This was surmounted by a wide, projecting, dangerous-looking cornice.

Leaving all superfluous kit and the instrument-coolie, who declined to venture up the wall, we attacked it, and in due time stood beneath the cornice. Three of us braced ourselves for holding on, while Zurbriggen, letting out a good length of rope, proceeded to breach the cornice at its thinnest part with his axe, and tread out a passage through its defiant front.

Presently he reached a safe position above, and we followed one by one through the chimney he had made, until all, after a tussle with an icy edge, were safely landed on the border of
the upper snow-plateau, from which the remaining snow-fields to the top were soon covered. The top, a rounded snow-dome, was reached in just five hours from camp. We named it Cornice Peak. The hypsometric readings compared with corresponding ones at lower station place its altitude at 17,814 feet. The temperature in the shade at noon (7th August) was $54^\circ$ F.

This climb added much to our knowledge of the topography of the region. We had an unobstructed view of nearly the whole of the Chogo Lungma glacier, and a splendid vision of its enclosing peaks and of the glittering coronet of Haramosh and its snowy sister-peaks. To the north, separated from us by a wide gap, rose three magnificent summits, which were destined to be the scene of part of our work the following year. Their flanks gave birth to an important tributary of the Chogo Lungma, of whose existence we had thus far known nothing, which sweeps down to the north of and directly beneath Cornice Peak. This was explored by us to its head some days later. The view suggested plenty of additional work, and we all agreed that Cornice Peak was worth the candle, in spite of the fact that its technical difficulties had proved greater than its height.

Descending, we passed with more measured tread through the crestfallen cornice, especially as the upper snow-world under the heat of the noonday sun had now softened to its most tender liquid mood, and small sizzling avalanches were already grooving the wall beneath. Thus warned, we took this last straight, lest otherwise we might start a larger avalanche, which would carry us down with it. The shale-slopes were treated more summarily than in coming up, when we slid back two feet for every three of advance. Now, digging in our heels, we glissaded down until brought up by some rock obstruction.

The following morning, the weather promising fair, we decided to lose no time in pushing further up the glacier.
We left camp at 7.30 with sixteen coolies carrying light outfit, and for the first two hours followed the slanting snow-beds on the mountain-side, till a point was reached above the séracs, opposite which the crevasses, though still large, diminished in number and the surface between them promised a convenient passage. We now struck off on the glacier, which from here ascends quite sharply.

We brought with us from Europe a pair of Norwegian skis to serve as runners for a light sledge which we had made in detachable sections. This idea was suggested by Sir Martin Conway, who used a sledge in his ascents in the Bolivian Andes. This was the first opportunity offered to us to test its value. As the glacial surface here appeared favourable to its use, we put it together, and piled upon it the loads of seven coolies, who were instructed how to manage it. They obeyed orders, but did not take kindly to the work and had to be constantly supervised.

We were now at 16,000 feet. The ice was covered by a light layer of snow, which increased in depth as we ascended. At first the sledge ran fairly well, but by the time the snow became four, then eight, then twelve inches deep and thoroughly softened by the sun's heat, the breadth of the ski runners did not prevent them from sinking deeply into it, while this same breadth caused the resistance of the snow to become so great that the combined efforts of the seven coolies and of Dr. Workman could only move the sledge a few yards without a rest.

The coolies, who were carrying loads, in spite of the slowness of their movements and frequent stops, gained greatly on the sledge, and it became evident that the use of the latter only served to tire the coolies and retard the march. It was therefore left in the snow, and the coolies, to their great relief, resumed their loads.

A sledge might be used to good advantage on ice or hard
snow in ascending or descending, where the gradients are not steep, but the resistance offered by soft snow more than neutralises any advantage it might otherwise possess. In any case, it is better to have the runners narrow. In marching over even fairly smooth glaciers or over snow, coolies carrying their loads according to their custom are likely to accomplish more than they would by using sledges.

By noon we were abreast of a large branch-glacier entering the Chogo Lungma from the south-west, the last and highest feeder on that side, which will be described later. All were sinking into the snow with every step so deeply that the coolies became discouraged and asked to return. This we absolutely refused to do, and told them they must go on. We suffered much from the sun's heat, which at noon registered 180° F. The coolies struggled slowly along under our urging, resting every twenty steps till about three o'clock, when they refused to go farther. They certainly had made a fair march, considering the circumstances, so we had them tread down the snow to make places for tents, and camped on the middle of the glacier at an altitude of 17,483 feet. This was named Glacier Camp.

After tents were pitched, we turned our attention to melting snow and boiling water over our primus stove for tea, with which to quench our thirst, which, after the heat and exertion, was excessive. Considering that it takes several times as long to bring snow to a boil as it does water, the process of satisfying our thirst was a prolonged one.

We were now well up toward the head of the glacier in a great ice basin covered with a thick mantle of perpetual snow and surrounded on all sides by very abrupt peaks, which were continually sending down avalanches on one side or another with a roar which could be heard for miles.

The next morning, at six o'clock, leaving the luggage-coolies behind, we started with guide, porter, and instrument-coolie, to
at the head of the Chogo Lungma. Ascend to the base of the great white wall, in which the glacier takes it origin. This last reach of glacier rises sharply in a series of great rounded hillocks towering one above another, interspersed here and there with numerous ice-chasms, the blue icicle-fringed depths of which could not be sounded by any means at our disposal. The ascent was fatiguing, being comparable to that of a stiff snow-mountain. Still, as the snow was hard and we were not held back by unwilling coolies, we pressed steadily upwards, and by eight o'clock reached our destination, the highest part of the glacier proper, which lies at an elevation of somewhat over 19,000 feet.

The snow-wall above it, which we estimated to be from 800 to 1,000 feet high, was steep, seamed with bergschrunds, and broken into an ice-fall; but we judged it could be climbed if
attacked early in the morning before its surface became softened by the sun. If we could reach its top we should be able to see what lay beyond, and perhaps to determine whether a passage existed to known regions to the west.

After having examined the surroundings and taken hypsometric and thermometric readings, we decided to descend and move the camp up to this point, so as to be able to start directly up the wall at dawn. By nine o'clock, when we began to return, the sun had softened the snow, so that we sank into it to the knees, which made the descent more fatiguing than the ascent.

On reaching camp we found the khansamah and coolies depressed in spirits, though not one of them appeared any the worse for their journey of the previous day. We told them we would remain here until the next morning and then move up higher. On hearing this some of the coolies complained of the cold and refused to stay. We now learned they had been too lazy to bring with them a warm woollen ground-sheet, which we had placed at their disposal for use in their tent. We offered to double their wages if they would remain.

Eight of them promised to do so, but at 3.30 that afternoon all but two deserted, saying nothing to us, and returned to the lower camp, leaving us helpless in the snow. The porter was immediately despatched to fetch others to replace them, while we proceeded to make ourselves as comfortable as possible in our snow-bivouac till he should return.

At nine o'clock next morning he reappeared with seventeen new men warmly clothed. When we saw them coming we packed our kit, struck tents, and got ready to move on their arrival, before they had time to indulge in any seditious deliberations. The khansamah and tent-servant, looking rather ashamed, said they would like to return to the lower camp. We consented, and at 9.30 o'clock left with the ignorant coolies, who had no idea of rendering us the least personal service, to
follow our route of the preceding day. Camp at the highest point we must, coûte que coûte.

The difficulties of this climb will be long remembered. The snow was soft when we started, and grew softer hour by hour. The higher we got, the deeper we sank in, and the greater was the exertion. The coolies stopped to rest every two minutes in spite of constant encouragement and admonition on our part. We had to make detours to avoid avalanches that were sweeping the glacier, and the glare and heat of the sun reflected from the driven snow were enervating.

Not far from the top we saw what we had never seen before, nor have since in such a place. On a snow-hummock in the centre of the glacier a solitary black bird, with orange beak and feet, about the size of a crow, was perched. When we drew near it flew off composedly toward a snow-peak, as it might have done to a tree lower down, and lighted on an ice-pinnacle of a hanging glacier far above. Its presence made an uncanny impression on our minds, and served to accentuate the almost terrifying desolation and loneliness of the place.

This was at over 18,000 feet, and for many miles on every side lay only peaks and glaciers. What could the bird find to live upon in that snow world? It was a chough, which lives at high altitudes, and is said to descend seldom as low as 6,000 feet, and then only in the depth of winter. This was the only bird of any kind we remember to have seen on the upper two-thirds of the Chogo Lungma.

We had to clamber over the débris-strewn beds of two large avalanches, which had swept down over the glacier to beyond its median line the preceding day, a fatiguing task. As we passed over the upper one, not liking the appearance of the snow-ramparts above it, we made a considerable detour, and tried to hurry the coolies, whose movements, as usual, were of the most leisurely character. They gave little heed to our admonitions, and would not quicken their pace.
ICE-BOUND HEIGHTS OF THE MUSTAGH.

The width of the glacier at this point is about a mile, the surface strongly undulating, and the mountain walls extremely steep. The last coolie had passed the danger point by only ten minutes, when we were startled by an ominous roar behind. Looking around, we saw what seemed to be the whole mountainside in motion. The huge curling cornice, that had graced its brow and excited our fears, had broken loose. Vast masses of snow and ice were sliding downward, rolling over one another, leaping through the air, and smashing themselves against the rocks with hissings, growlings, and crashings, as if all the demons of the infernal regions were venting their wrath on that mountain-wall. Thick clouds of snow-dust were thrown hundreds of feet in the air.

As the mass struck the glacier it seemed to hesitate a moment, then gathering head, with a high, seething front, at least half a mile wide, it shot across the glacier, regardless of undulations and gradients, with a roar such as might be produced by fifty railway trains running abreast at high speed, leaving in its path a chaos that must be seen to be appreciated, till it finally expended its force well over towards the farther side of the glacier. The cloud of snow-dust raised by it rolled majestically onward till dissipated on the opposite heights. The forces of Nature among these great mountains, when dormant, pass unobserved, but when roused to action, be they those of air, water, rock, or snow, the effects are indescribably sublime and awe-inspiring.

The top of the glacier was reached, much to our relief, after four hours of stiff work, during the last hour of which we felt doubtful whether the coolies would hold out to the end. Two of them assisted in pitching the tents, but the rest threw themselves flat on the snow, not offering to help in any way. They were doubtless exhausted, but certainly not ill, and the next morning were in good condition.

The conquest of the Chogo Lungma was completed. It had
given us much hard work and some exciting adventures. This was, however, only one stage of our exploratory programme, and much more remained to be done. The Chogo Lungma has about the same length as the Biafo glacier, which we ascended in 1899. The tongues of the two glaciers end at approximately the same altitude, but the Chogo Lungma rises some 3,000 feet higher than the Biafo, and its upper fourth is more deeply snow-covered. Its surface is much steeper and more broken; the enclosing mountains of its upper half are higher, more snowy, overhang it more abruptly, and send down avalanches that sweep over it, which last cannot be said of any part of the Biafo. It is, therefore, a good deal more difficult, and certainly more dangerous, to explore than the Biafo.

Our tents were pitched in sugary snow about twenty inches deep, which could be broken up, but could not be trodden into.
a smooth surface. It would be hard to find a more arctic camping ground than this at 19,000 feet, backed by immense, cheerless, snow-walls, that rained down avalanches at all hours of day and night. We considered it to be within the limits of safety, but it is by no means certain that an unusually large avalanche might not have come down and overwhelmed us, as the one we had so narrowly escaped had swept over the glacier below. This was named Foggy Camp. It lay some 200 feet below the base of the snow wall in which the glacier has its origin, and its altitude worked out at 18,994 feet. The col at the top of the wall we call Chogo Col.

During the afternoon we made preparations to attack the wall at daylight, and Zurbriggen trod out steps for three hundred feet up to the base of its ice-fall. Alas for our plans! In the early hours of the morning snow and sleet were heard pelting on the tents. When we got up at five o'clock, in a temperature of 20° F., the sky was overcast and thick mist was rolling over the col and down the wall, which last, although we were so near it, was soon entirely lost to view. The barometers fell rapidly. The reservoir of a high glacier is not a safe place to be caught in by a severe storm, such as we judged from appearances was now about to break, so we hurriedly packed our kit, struck our ice-coated tents, and began a retreat to our camp of refuge six hours below on the mountain-side.

We could not see the mountains on either hand, but fortunately had our track to follow, till later the air cleared somewhat, so that landmarks could be distinguished. By ten o'clock snow was falling fast and thick. At one we reached Sérac Camp, and pitched tents in four inches of snow on the stone terraces previously built. That storm lasted sixty hours, during which time we were kept busy clearing away the snow from and about our tents.

The intervals in this occupation we spent without fire under the canvas darkened by the rapidly accumulating layer of snow.
outside, in a temperature varying from 40° to 30° F., trying to keep warm by wearing our thickest clothing, with feet encased in felt Gilgit boots, heads in thick Jaeger caps, and hands in fur gloves. Whenever the tent-flaps were drawn open for a moment, a cloud of snow swept in and swirled through the interior, covering everything with crystal flakes. At night, as we lay in our sleeping-bags listening to the creaking of tent-cords and flapping of the canvas walls, we could not repress a feeling of anxiety, lest the next gust should wreck the whole frail structure, or an avalanche born of the snow-storm overwhelm and carry us away.

Those not used to camping on snow can scarcely realise what it means to be imprisoned in a small tent during a storm of such length and severity, when the snow increases foot by foot in depth, in spite of efforts to remove it, and the tent, unless
cleared often of the load accumulating upon it, is likely to collapse upon you as you sit within.

The morning after our arrival the fifty-five coolies, having wasted the slender wood-supply in cooking chapatis for themselves throughout the night, deserted en masse, leaving us with the camp-servants to weather the storm. The fact that they left during the height of the storm, with the driving snow shutting out all landmarks, to descend the broken glacier, shows how little they appreciated the danger to which they exposed themselves, and their ability to find their way under such circumstances shows how little ground they had for their panic six days earlier. After two days and a half the storm ceased, and the mist lifted from our frigid perch, disclosing the most wintry landscape it is possible to imagine.

Two days later, as the last stick of the wood brought with us was being burned, a relay of forty coolies sent up by the lambardar to our rescue arrived. Striking tents we marched down to Riffel Camp, revelling in the blazing sunshine after the dark days of hardship and privation on the great glacier.

A winter storm in Europe is but a bagatelle in comparison with one in the Himalayan ice-world, and the grandest view in the Alps on a fair day is a mere nothing to the radiant, sunlit scene on the upper reaches of the Chogo Lungma.
HARAMOSH GLACIER FROM RIFFEL CAMP TO MT. HARAMOSH, 24,270 FEET, AT UPPER END.
LENGTH ELEVEN MILES.
CHAPTER VI.

Up Haramosh Glacier—Estimation of Altitude, Distance and Obstacles—Ascent of Haramosh to Col in Storm—Camping by Night—A Wily Balti.

A beautiful ice-stream descends from a broad snow-covered ice-defile at the base of the northern face of Mt. Haramosh in a sweep eleven and a half miles long to its junction with the Chogo Lungma opposite the point of Riffel promontory. Its surface is seamed with transverse crevasses from beginning to end. Its gradient is less sharp than that of the upper Chogo Lungma, the rise being 3,400 feet in eleven and a half miles, while that of the latter is 5,000 feet in nine miles. Still, as we looked backward from its upper parts on the course we had followed, we realised that we had been ascending.

This glacier, coming from one of the most icy regions of this part of the Karakoram, is active, and presses strongly on the main stream of the Chogo Lungma, making its influence felt for a long distance after its junction with the latter.

It is something over three-quarters of a mile wide at its lower end, and holds this width for a long distance up, widening out where it receives two short branches, opposite each other, about four miles below its upper end, and narrowing again as it approaches Mt. Haramosh. It is enclosed on both sides by massive ice-bound walls of over 20,000 feet, culminating in Mt. Haramosh, 24,270 feet.

On 16th August, we left Riffel Camp, with fourteen coolies, to ascend this glacier. We also took a village headman named Rustum, who had attached himself to the expedition, to superintend the coolies. Descending the steep rocks below the camp we soon found ourselves in a sea of large seracs, through which
we had to find a path. We then crossed the glacier to its south side to avoid the crevasses with which its central portion was seamed. Here no serious obstacle presented itself, and steady upward progress was made.

On this part of the glacier there were quite a number of glacial tables, some of them of large size, the ice-shafts supporting the stone-tops being of considerably smaller diameter than the latter, and varying from five to ten feet in height. There were also shafts standing alone from which the stones had slid off.

The weather, fine at six, became uncertain as the day wore on, thick mist hanging over the mountains at times and then
SECOND HARAMOSH PEAK, 21,950 FEET, NEAR HEAD OF HARAMOSH GLACIER.
disappearing. Now and again we were enveloped in passing
snow-squalls, in the intervals of which Haramosh, throwing off
its misty veil, loomed nearer and grander as we advanced. It
has a sister-peak fixed by the Indian Survey at 21,948 feet, which
at a bend in the route burst into full view, flaked near the top
with feathery cloud.

Mountains, like people, have their individuality. Some are
always commonplace, no matter how high they tower, but this
mountain is remarkable, in that, on this side, it rises in tumbled
masses of glittering ice from the glacier to the base of its final
cone. It seems strikingly tall and graceful from here, as well
as when viewed from farther afield. It has three summits, the
highest, a slender, perfectly proportioned pyramid, being the only
one seen from the high peaks farther north.

The new snow deposited by the late storms told on our speed
as we got higher, and the caravan no longer moved with ease
over a frozen surface, but was ankle-deep in wet snow. At noon,
having accomplished just half the length of the glacier, we sat
down on our mackintoshes and ate a cold tiffin mixed with
snowflakes. The coolies settled themselves in the snow as if
they never intended to move again, each making a raid on his
supply of chapatis.

During this noon-halt the clouds gave way to blue sky and
sunshine for a time. The head of the glacier appeared quite
near. The question of leaving the coolies where they were and
of our trying to reach it that afternoon was mooted by Zurbrig-
gen, who estimated it to be only an hour and a half distant, and
said if we started at once we could reach it and return before
darkness set in. He strongly advised attempting this, lest the
weather should be worse the next day. Not agreeing with him
as to distance, we finally, against our judgment, consented to try
it. We have always found it advisable in Himalaya, where
distances are very deceptive, to camp as near the objective point
as possible, and to start early in the day to reach it. One
seldom has too much time, and in any case too much is better than too little.

There are two factors in Himalayan climbing which it is difficult to determine with any degree of exactness at the beginning of the ascent, viz., distances and obstacles. This is true to some extent of lower mountain regions, but to no such extent as among these Asiatic giants. The pigmy dimensions of the Alps and other lower ranges afford no adequate training ground for him who would judge of Himalayan distance. Persons accustomed to European standards, be they guides, porters, surveyors, or others, when first thrown among these greater mountains are liable—if not almost certain—to estimate distance, both horizontal and vertical, at less than it really is. Their standards are inadequate to the task. This fact is accounted for by the much greater altitude and dimensions of the Himalayan snow-world, and by the wonderfully clear atmosphere, which causes distant points to appear near. The mind is also dazed and overwhelmed by the immensity, and fails to comprehend it.

On the contrary, when a course has been completed or a height attained, the mind of the inexperienced is so impressed by the length of time taken to accomplish the task that there is a tendency to swing around to the opposite extreme and overestimate the distance covered, and particularly the altitude reached.

The opinion of a person on his first visit to Himalaya as to the size or altitude of one of its great mountains, when viewed from near its base, is not of much value. The power to estimate these as well as horizontal distance is gained only by experience, by an intimate acquaintance with mountain, glacier, and plain, acquired by ascending and exploring them, not by viewing them from afar.

Such estimate can be made more accurately during a second season and still more so during a third. One must live among
WALL OVER 20,000 FEET IN ALTITUDE AT JUNCTION OF HARAMOSH GLACIER WITH CHOLO LUNGMA, SWEEP CONSTANTLY BY AVALANCHES.
ESTIMATION OF DISTANCE AND OBSTACLES. 129

them summer after summer, absorbing something of their atmosphere to acquire the ability to form a proper conception of their vastness and awful unconquerableness.

Even the most experienced do not find it always easy to estimate distance correctly. In examining a high mountain from below, arêtes are fore-shortened, and features widely separated appear near together. It is difficult to judge of the size of a large snow-basin, even when one is standing on its edge, and the same is true of extensive snow-fields unbroken by rocks that may serve as landmarks for comparison.

Experience aside, ability to estimate distance varies greatly with different individuals. Some persons can estimate distance, both vertical and horizontal, with a close approximation to the reality, while others, no matter how much experience they may have had, can never judge of the same with any degree of exactness. This is shown by careless statements confidently made, and is seen on maps of little known regions, where estimated distances form a not inconsiderable part of the work. Hence the impropriety of placing estimated altitudes against those that have been measured by one of the methods recognised by science.

Still more difficult is it to determine in advance the obstacles that may be encountered on a high mountain. However gentle its declivities may appear from a distance, some of them on nearer approach may develop into impassable precipices. Dangerous galleries may present themselves which could not be detected on reconnaissance. Its apparent snow-slopes may be found to be ice of too steep a gradient or in too precarious a condition to be attempted. Certain passages which must be traversed may be swept by avalanches of stones or snow, or further progress may be cut off by crevasses or bergschrunds.

In view of this it is vain to assert that an untried Himalayan peak, towering thousands of feet above the valley-level, can be climbed. The most that can be said is, that the appearance
of the visible slopes warrants an attempt. The issue alone of the attempt can give a probable or decisive answer to the question.

Time and again in the course of our Himalayan exploration we have found distance deceptive both on mountains and passes, especially snow-passes, and on every one of the considerable number of high peaks of which we have made first ascents, obstacles have been encountered which were not discoverable during previous reconnaissance.

The present occasion was a case in point. After a hasty lunch we continued on, leaving the coolies to await our return, who were soon shut out from view by the mist. The new snow became deeper as we ascended. We had seldom seen it in worse condition. It balled up on the soles of our boots in great masses, so that we could not advance without knocking
MT. HARAMOSH NORTH FACE, 24,270 FEET, AND UPPER FIVE MILES HARAMOSH GLACIER. TELEPHOTO FROM RIFFEL CAMP ELEVEN MILES DISTANT.
it off every few steps with our axes. Squalls again swept over us, and after three o'clock no further breaks in the weather occurred; it snowed steadily.

It is difficult to conceive why we kept on. Probably the motive that influences many mountaineers, not to turn back except from sheer necessity, governed us. Later there was no question of knocking snow from our boots. It became so deep and its lower layers so cold that it ceased to ball. By four o'clock its depth measured two feet seven inches, but we still plunged along, dragging one leg laboriously after the other.

Fortunately the gradient was steep only in a few places, in getting up which we had the exciting pleasure of sinking into the snow up to the shoulders. It was not climbing, but rather wrestling with the pass.

Zurbriggen's hour and a half had lengthened into four when we saw a large ice-ridge ahead. Pressing forward with all our remaining strength through the heavy snow we surmounted this, and at five o'clock reached what might be called a col at the head of the glacier, at the entrance of a long, desolate ice-defile, about a mile wide, cleft at short intervals by tremendous crevasses and heavily covered with snow. Its broad surface reminded us of the Hispar pass, with the difference that the Hispar, when we stood upon it, was one vast sweep of driven snow unbroken by a single crevasse.

After a little the mist, which for three hours had covered mountain and glacier with a thick pall, lifted, and Haramosh was seen towering up just ahead, a solemn, awesome snow-massif against the colourless sky. Other peaks unshrouded themselves, torn and ragged, encased in shaggy masses of ice, which, seamed by enormous chasms, rolled down from their shoulders in frozen cascades. The long glacier we had plodded up fell away behind, a furrowed winding sheet of snow. Not a rock relieved the monotony of white. The scene was not beautiful; it was impressively weird, unearthly, ghastly.
During the break in the mist we obtained a view through the defile which forms a pass or la. This glacier, here making a turn to the west, runs under the wall of Haramosh, and drops steeply down to a valley, wooded in its lower part, leading to the Indus in the direction of Gilgit. The readings give the altitude of the col as 17,412 feet. We named this pass the Haramosh La.

The day was too advanced to permit of our remaining long in the deep snow on a pass of over 17,000 feet, so at five-thirty we started to return. It was growing cold, but our efforts to escape from this upper wilderness before nightfall prevented our feeling this. With the deepening twilight the sky cleared, and, as we ploughed our way over the trail made in ascending, star after star appeared, pulsing solemnly above our lonely path. It was a long and weary pull, for we were well-nigh exhausted.

At eight-thirty we came upon the coolies, sitting much as
we had left them at noon. Rustum had had the forethought to have one tent put up, but no other preparations for our comfort had been made. Had a properly arranged camp welcomed us, we should not have minded the weariness or the freezing temperature. On an occasion like this small matters assume gigantic proportions, and the search for candles, lanterns, primus stove, and provisions, with shivering limbs and aching fingers in the icy wind was a heavy task, and the pitching of two frozen tents a still heavier one.

By ten-thirty we were housed, and snow was melted and boiled for a hot drink, which has a most soothing effect in such cases. This camp at 15,960 feet was named Haramosh Camp, and the glacier Haramosh Glacier after its dominating peak. At six o'clock the next morning the glass indicated 13° F. The day being fine, we went two hours up the glacier again to photograph, and returned to Riffel Camp in the afternoon.

The wiliness of the Balti was often brought home to us during this and the following season. He will sometimes make a trying march and endure hardship at high camps without complaint, but a day or two later he will feign illness, and ask to be discharged. Another ruse, already mentioned, which may work successfully with the uninitiated, whose tender sympathies it is calculated to arouse, was now tried on us by Rustum.

His trip up the glacier and night at Haramosh Camp, though matters of no hardship to him, had apparently satisfied his desire for exploration. The day after the return to Riffel Camp he received word of the death of his mother, and asked to be allowed to depart immediately. As wireless telegraphy had not penetrated to that remote region, and no one had come up from Arandu to the camp that day, the story of his bereavement was transparent. As it was evident, being dissatisfied, he would no longer be of use, and his influence with other coolies might be bad, he was paid off and told he might leave at once.
We took the precaution to make him deliver up the nailed boots and socks which had been loaned him for the glacial work. But he proved himself a clever rascal, for, having been paid, he appeared in no hurry to go, and remained until the next morning. Meanwhile, in the night, he visited the box where the boots were kept, and took them away with him. On our return at the end of the season, as we went through his village, we saw him wearing the boots thus appropriated.
CHAPTER VII.


We next turned our attention to the glacier discovered from Cornice Peak, which forms the uppermost tributary of the Chogo Lungma on the north side. It originates in the walls of the highest and dominant peak of the region, and, running south-east, makes a wide bend to the south near its end, and tumbles into the Chogo Lungma above Riffel promontory in a large, much shattered ice-fall three quarters of a mile long. This glacier is seven miles long and three quarters of a mile to a mile wide throughout its course.

On the morning of 19th August it was snowing hard at five o'clock. At six the storm apparently cleared, and at seven-forty we left camp with nineteen coolies and crossed the Chogo Lungma to the base of a steep grass and rock slope forming the eastern barrier of the ice-fall. While crossing the glacier the storm broke upon us again with redoubled force, and from eight to ten o'clock the air was so filled with snow as to shut out the mountains on both sides completely from view.

Ascending the steep slope for two hours, we reached a point several hundred feet higher than the head of the ice-fall, on a shaly arête overhanging the new glacier, at the edge of a snow-field where we camped. On the slope we saw some twenty ibex, which fled as we approached, and innumerable traces of others. This suggested a name for Ibex Camp. Its altitude was 15,110 feet. Here we built a stone-cairn.

From Ibex Camp there was an unobstructed view of the whole
length of the glacier, which, spreading out into a broad basin above the ice-fall, runs straight away without a branch to the great snowy pyramid-peak at its head which gives it birth. It is further fed from the precipitous snow-walls by which it is bounded on both sides, and from which several beautiful rock-crests rise on the north-east side. We called this Basin Glacier. Ibex Camp also commanded an equally clear view down the Chogo Lungma for twenty miles.

The night was fine. The minimum temperature was 20° F. Starting the next morning at seven, we descended to the glacier, the surface of which was in good condition, and found a convenient passage with a gentle rise up its first half. The gradient then became increasingly steeper and crevasses more frequent, until at last they seamed the glacier in all directions, ready to serve as pitfalls for the caravan.

The day was oppressively hot. The high walls enclosing the glacier shut off all breezes, and the sun burned with fiery fervour through a film of cirrho-stratus cloud. Its heat reflected from the dazzling whiteness of the newly-fallen snow struck us like the radiation from a blast-furnace, blistering our faces, already burned to a deep copper colour, from chin to forehead under our sola topis. The temperature in the sun at one p.m., even through the clouds, as registered by the solar thermometer, was 183° F., sufficiently high to cause great discomfort, though by no means one of our highest temperatures.

By one o'clock we had reached practically the head of the glacier, where it ascends sharply to join the névé covering the mountain slopes, about as far as it was safe to go. Leaving the coolies to follow under the direction of the porter, we went over to the east side with Zurbriggen to select a place to camp. A spot was found on one of the snow-covered, rising ice-hillocks, surrounded on three sides by wide crevasses, into which numerous smaller ones entered, that appeared safe from avalanches, though we could not have moved many yards from our
tents with safety after dark. We trod down the snow and seated ourselves in the singeing sun and breezeless air to await the arrival of the coolies, meanwhile occupying the time in taking hypsometric, aneroid and thermometric readings.

At two o'clock the caravan arrived and camp was immediately pitched. It was called Crevasse Camp. Its altitude was 17,500 feet. The mountains rose around us in tremendous unscalable precipices. There was only one point where anything resembling a col could be seen, and this was at the top of a very steep avalanche-scored wall, where two small depressions, one on either side of a sharp quartzite-crest, which might be called cols, existed. They did not appear likely to afford a passage to the other side of the ridge, but might afford a view of what lay beyond it. Therefore we determined to accept the gauntlet which this wall threw down and attempt its conquest.

The night was clear and cold, the minimum temperature being \(12^\circ\) F., which was favourable as it hardened the snow. On account of the danger from crevasses we waited till daylight of the 21st August to start.

Our path at first lay over the rapidly-ascending crevassed glacier, then up the still steeper débris of a recently fallen, avalanche, where for a few steps the foothold would be firm and for the next half-dozen we would flounder waist-high in soft snow. Above this came a wide bergschrund, over which only a single insecure snow-bridge was found. This passed in safety we had before us the ice-wall, which was steep from first to last, varying as measured by the clinometer at different points a few degrees either way from \(60^\circ\). It was covered to a greater or less depth with snow, which was now hard-frozen and remained so till nearly noon, as the wall, running north and south on the east side of the valley, did not feel the force of the sun's rays till after eleven o'clock. Hence on the ascent every step had to be cut from bottom to top.

A series of rocks projected through the ice at intervals of a
few hundred feet, and we laid our course from one to another of these. After two and a half hours we reached the last rock, after which we had before us only the blank ice-slope, which stretched several hundred feet upward to the foot of the perpendicular crest above. We had intended to strike directly from the last rock to the right-hand col, which, though not so high as the other, was much nearer our route; but we found the slope at this point to be of smooth ice of 60° incline, thinly covered with fresh snow and too dangerous to attempt.

We therefore decided to turn to the left, where the snow was deeper and the foothold better, gain the base of the rock-crest, and, with what handholds it might offer, traverse the upper edge of the ice-slant where it joined the rock-face, and thus reach the left-hand col.

After another hour and a half of laborious step-cutting we got to the base of the rock-crest, which was found to consist of rotten and crumbling impure quartzite so weathered as to afford but few handholds, and these had to be used with the greatest caution lest they should scale off.

The upper edge of the ice did not lie close against the rock, but was separated from it by an interval or schrund varying from six inches to three feet in width and of unknown depth. The steps cut along this edge, which was more or less brittle, made a more precarious path even than those on the slant below, and in the absence of handholds progress was necessarily slow. To add to the difficulty transverse crevasses existed at intervals, some of them covered with snow, into which there was danger of falling. It was a most uncanny path over which we cautiously pursued our way for more than two hours.

At one o'clock we reached the col, a sharp edge with a drop on the farther side, steeper than the wall by which we had ascended, ending in a precipice which overhung a large glacial ice-fall. It overlooked a vast trefoil basin surrounded by massive jagged mountains, which cut off all view beyond and sent down
ON THE BHAYAKARA COL.

a complex of glaciers and ice-falls to form a large branch of the Chogo Lungma, which we afterwards explored almost to the top of its highest ice-fall. To anyone inclined to vertigo the downward view on our side would have been appalling—a sheer sweep of almost 2,000 feet of precipitous wall to the abyss where clung our Mummery tents like green locusts snared in a snowy lair.

There was barely standing-room, and no opportunity to take hypsometric readings, so we had to rely on those of our Watkin aneroids, which had been checked the previous afternoon at Crevasse Camp by the boiling-point thermometers. One of them differed from the latter by only plus one-hundredth inch. Their readings, compared with those at the same hour at Skardo, gave M. I.
the height of this col as 19,260 feet, 1,760 feet above Crevasse Camp.

For the last two hours the midday sun had shone upon our path, and, crowded as we were against the rock-wall, its heat was almost unendurable. The shade temperature could not be obtained, as there was no shade except that cast by our bodies. In our shadow the temperature was 80° F., but the sun burned like a live coal, the few fleecy clouds scudding over the sky in no way tempering its ardour. Its rays struck with savage energy perpendicularly on the ice-wall, and by this time had softened its covering of snow.

We did not remain long at the col, partly because there was no convenient standing-place, and partly because we were anxious about the descent. It was evident to all that, owing to the softened snow, the latter would be more dangerous than the ascent, as the steps cut with so much care would no longer afford a firm foothold. We soon found, our feet sank through them from a few inches to two feet till stopped by solid ice beneath.

We returned slowly and painfully along the treacherous edge in the pitiless heat, finding neither hand nor satisfactory axe-holds. Every now and again someone would slip on an insecure place. After going a short distance, Zurbriggen said, “Es ist sehr gefährlich. Wir kommen heute nicht hinunter.” This was the first time we had known him to lose courage. We replied, “If we do not get down to-day we shall not get down alive.” Whatever might be in store for us on the descent, to remain where we were would be certain death. No shelter of any kind was to be found on that wall. There was not a place where one could sit down to rest. We should be obliged to stand in the narrow steps on which our feet rested till we dropped from fatigue, which would mean a slide of nearly 2,000 feet down the avalanche-gullied ice-slope into eternity. Could we manage to stand there, we should be frozen stiff in
Peak above Basen Glacier, touched by mist.
our tracks before morning, as the temperature would drop to zero. As a German friend remarked of this descent, it required "Todesmut" to do it, but nothing remained but to go on and take the chances.

It was now two o'clock, and, having eaten nothing since eight that morning, we were becoming faint. We had been so occupied we had not thought of lunch. We stopped in our tracks, drove in our axes as firmly as possible, took from a rucksack a few kola biscuits, chocolate, and a tin of pâté, off which we made a hurried meal, and then crept on again.

Shortly after this the porter, who was second in the line, lost his footing completely and dangled helplessly on the rope. Zurbriggen, who was last and somewhat above, having his axe secure in a narrow crevasse and the rope round it, was able to hold firmly, while the other two, though by no means securely placed, by the aid of their axes prevented themselves from being pulled off. The porter, being thus supported at both ends and sternly admonished by Zurbriggen, soon regained his feet. We had a narrow escape, and after this redoubled our caution.

When we came to the place where our track left the rock face and led diagonally down the snow-covered slope, prudence suggested we should not follow it further for fear of starting an avalanche. We went straight down backward in order to avoid this mishap. Zurbriggen fixed his axe firmly, and wound the rope round it to hold us in case of accident. The porter then taking the lead went down as far as the rope would permit, treading out steps. When he had braced himself, Nos. two and three followed in like manner, and lastly Zurbriggen descended and secured himself anew. Yard by yard the great slope rose above us, as, like snails, we made our way toward lower level and safety. At last we reached some rocks, from which our spoor was again regained.

It was now five o'clock and we saw with delight the sun fall
behind the western peaks, and the shadows, which meant better snow-conditions, spread rapidly over the glacier and aslant our wall. The snow soon stiffened, so that we were able to resume the forward position. On turning we beheld the coolies gazing spellbound at our, to them, strange actions.

Although we still sank knee-deep in the snow at every step we reached the burgschrund without accident. Here the snow-bridge was found so soft that we did not venture to use it, but jumped the schrund into the snow below. We reached camp at six o'clock, having had twelve hours of continuous mental and physical tension without a single rest.

Thus ended this adventurous ascent to a col, which we named the Bhayakara Col, from the Sanskrit word for perilous; Zurbriggen called it the most dangerous one he had ever made.
The temperature fell during the night to 9° F. The next morning, none the worse for the climb, except for bruised hands and burned faces, we descended over Ibex Camp to Riffel Camp. The next five days were spent at Riffel Camp, the first two being occupied with some arrangements which had to be attended to, the others being stormy, so that it was not till 28th August that we were able to start to explore the next highest north branch of the Chogo Lungma, which enters the latter directly opposite Riffel promontory.

The three high glaciers already explored had been entirely of ice and snow, without moraines and carrying little or no visible rock-debris; but the whole width of this one, about half a mile, was occupied by three well-marked median moraines, of which the most easterly was composed of black slate and shale, the central of grey quartzite, while the westerly one was grey on its east and black on its west side. We called it Moraine Glacier.

The main trunk was rather free from crevasses, and we ascended it without difficulty on smooth ice in the furrow between two of the moraines. About noon, after rounding a wide curve, we came to a point at the entrance of the large trefoil basin already mentioned as seen from the Bhayakara Col, where the glacier divides into three branches, running into the three divisions of the basin, one to north-east, one to north, and one to west. After this division the ice becomes much broken, stretching out in continued reaches of séracs and ice-falls till it ends in névé.

The basin is enclosed by high, jagged, riven mountains, the sides of which collect a large amount of snow and send down vast quantities of detritus, which mingle with and covers the ice in a most intricate manner, forming extensive moraines, which only assume an orderly arrangement on approaching the head of the trunk-glacier. Such a chaotic mixture of detritus, boulders, séracs, ice-falls, and moraines we have nowhere else seen.
ICE-BOUND HEIGHTS OF THE MUSTAGH.

The west and north divisions of the basin being so split up as to be apparently impenetrable, and ending in cul-de-sacs without any openings in the mountain walls, that we could see, we followed the north-east one, at the top of which a passage or col between two peaks existed, though its character could not be determined from here.

We ascended a rough and steep moraine, rising in great hummocks along the side of the ice-fall and lying partly upon it, and after two hours came to a boulder-covered spot more level than the rest, at an altitude of 15,204 feet, where camp was pitched. To make places for the tents, stones had to be rolled away and hollows filled up with others. This was named Hummock Camp.

The next morning we were up early. The sky was cloudless, promising a fine day, except for a narrow stripe of thin haze just above the extreme southern horizon. During the monsoon we found the existence of cirrho-stratus clouds, even of extreme tenuity, whether over the whole sky or at the horizon, to be an unfailing sign of approaching storm. When these were seen, a storm was sure to break within twenty-four, generally within twelve, often within six, and sometimes within three hours. After the monsoon ceases these clouds are less significant.

In view of the suddenness with which Himalayan storms may develop, and the savage and broken character of the region, this sign of bad weather made us hesitate about starting, but we finally concluded to do so and trust to luck to get back before the storm should break.

Accordingly we left camp shortly after four o'clock, and followed the rough moraine, which led upward through the nala. After giving us a trying scramble, the moraine ended at a high snow-shoulder under the perpendicular rock-precipices of a granite mountain, which rose above a steep ice-fall descending between it and another equally precipitous mountain in a beautiful cascade. Some five hundred feet above its base the
brow of the cascade was formed by three huge masses of ice extending completely across it. These did not suggest a col, but rather a continuation of the glacier, forming perhaps a pass, but more probably leading into another higher mountain basin.

With the object of determining this we went on over the snow-shoulder and descended to the ice-fall, which we crossed to its farther side, where the ascent of it promised to be easiest.

We cut our way up through a labyrinth of glittering séracs and ice-gendarmes, separated by wide crevasses reflecting from their depths a fascinating, indescribable blue, and across the whitest of snow bridges, to tread which seemed almost sacrilege, so shimmering were they with exquisite virgin purity. The overcoming of each ice-pinnacle involved a physical and mental tour de force.

By eight o’clock the hazy stripe above the southern horizon
had spread itself over the whole sky, and by half-past eight a thick mist rolled down over the surrounding peaks, obscuring the sun, but we still pressed on, though we now felt we should soon be obliged to turn. At nine snow began to fall, which added a decisive factor to the situation. Retreat was now the only alternative, as the ice-fall, dangerous enough in clear weather, would now become a network of horrible possibilities. Stopping only to take readings for altitude, we made our way downward as fast as possible, reaching camp about noon. The altitude attained was 17,091 feet. The storm showing no sign of abating, we continued on to Riffel Camp, which was reached late in the afternoon.

On 29th and 30th August heavy snow fell on all the peaks and spread a white mantle over the Chogo Lungma. This
ICE-GENDARME, MORAIN GLACIER.
marked the end of a very unsettled season, during which there were rarely more than two consecutive pleasant days, and only once did the number amount to four. As from this time on,

with lengthening nights and cooler temperature, the snow was likely to increase and interfere with high work, we left Riffel Camp for the last time on 1st September, and headed for Arandu. Here disbanding the coolies, and retaining only M.
those needed for the next march, we descended the Basha valley.

John was sent to Srinagar via Skardo with part of the luggage, while we took the route to Rondu by a nala leading west from Hemasil to the Ganto La. The path zigzags up a steep, partly grass-covered alp to the pass, a rock col 15,100 feet high, thence descending through a nala to a torrent. Two paths lead from the Ganto La to the torrent, an upper one along the rock-face, which requires some care, being narrow and steep, and a lower one easy to follow. Thence on to Haramul and Dasso, which last is two fair marches from Hemasil.

At all villages the harvest grain was being threshed by driving over it four to six yaks, which, harnessed abreast, moved in a circle around an upright pole. The yaks were driven by both men and women, who held them by the tails. They would root up by their noses the straw they were treading. The custom of threshing grain in this manner prevails all over India, and has spread as far westward as Spain, where it is still employed (see "Sketches Awheel in Fin de Siècle Iberia," p. 221). Shortly before Dasso a lambardar met us with a present of a basket of the most delicious apricots we have ever tasted.

Leaving Dasso with forty coolies, we marched for five hours up and down uninteresting, barren hillsides bordering the Indus, till we came to a place where the valley narrows greatly and is enclosed by two high, perpendicular cliffs, the space between which is completely filled by the river. At the narrowest point, perhaps five hundred feet wide, high over the rushing, turbid, reddish-brown stream, hangs the longest jhula bridge we have seen in Himalaya. To reach it one has to descend the face of the cliff on inclined ledges or shelves of granite, polished smooth by the frequent pressure of naked feet, and connected by ladders at the worst places, a descent better adapted to bare feet or grass shoes than to nailed mountain boots.

The bridge was not in the best condition, many of the withes
that hold the lower foot-strands together and connect them with the upper strands being broken, so that, unless care was exercised, one's foot might slip between them into empty space. It took thirteen to sixteen minutes for different members of the party to cross this jhula. Twenty minutes' walk beyond it is Mendai or Rondu.

In all the valleys of this region for 1,000 to 2,000 feet above the streams were seen signs of extensive water-erosion similar to those noted in the Dras and Indus valleys above Skardo. Potholes in all sorts of fantastic forms were washed out of the solid granite. Huge boulders as large as small houses were honeycombed, and some had holes completely through them. As said of those before mentioned, the shapes and situation of these show that the direction of the currents that produced them was the same as that of the present streams.

It was very warm at Rondu, the temperature in the tents at four o'clock p.m. being 88° F. From here the breezeless sun-baked Rondu nala was ascended to a side-nala leading south to Harpo. Shortly after passing Thursay we turned west and followed the trail leading to the Trongo Pir, much to the disappointment of the coolies, who preferred to cross the much easier Harpo La, the route taken by most travellers from Rondu to Astor.

After ascending a steep grassy slope we descended again into the Trongo nala, a fine partly-wooded high valley, at that season covered with low red bushes and patches of long-petalled flowers, which, according as the sun fell aslant the slopes, varied in hue from dull cranberry to deep scarlet, causing the whole valley to appear as if carpeted with sheeny silken Bokhara rugs.

Following up the nala to the last vegetation, we camped on the edge of a moraine at 12,600 feet. Starting the next morning we ascended a rough, boulder-strewn moraine without trace of a path till noon. This was succeeded by a snow-field, up
which we marched till one-thirty, when the top of the pass was reached. The passage over it consists of a small fissure, just large enough to admit one person, in a perpendicular rock-crest projecting above the glacier. The height of the Trongo Pir is probably something over 16,000 feet. Having no longer base-station readings for comparison we took only aneroid readings, which admit of a range of estimate between 15,600 and 16,700 feet.

The descent takes one down a steep scree-slant to a snowfield. This passed, there is an hour and a half of scrambling over a wilderness of massive irregular blocks of granite thrown one over another in chaotic confusion, neither an easy nor a safe operation. We were often obliged to jump from one to another across intervals, which, had one fallen into them, would have proved as dangerous as glacial crevasses. Whence these
blocks came, or how they reached their present position in the
middle of a broad slope is not evident, for there are no peaks
in the immediate vicinity from which they could have fallen.

Then a descent over smoother inclines brings one to a grassy
margin far above tree growth, intersected by a shallow pebbly
stream of clear water. When we came to this at four p.m. its
brilliant autumn-tinted carpet of vegetation flashing in the
slanting light of the afternoon-sun made it seem like a haven of
rest after the rough and dreary passage of the Trongo Pir.
Here we camped, and could have spent a week with pleasure
in its quiet seclusion had time permitted.

From the Trongo nala over the pass and for some distance below
this camp no path exists, and the pass is seldom crossed. Farther
down a path was found which joins that from the Harpo La in
the Harpo nala. Without further adventure we reached Astor,
whence following the Gilgit road to Gurais, we returned to
Srinagar, reaching it on 28th September, thus ending a season
of three and a half months of successful exploration.
CHAPTER VIII.


The village of Arandu lies at an altitude of 9,500 feet on an alluvial terrace directly in front of the converging tongues of the Tippur glacier on the south and the Chogo Lungma on the west, in an apparently dangerous situation, as a decided advance of or a heavy flood from either glacier would overwhelm and destroy it. This terrace differs from the other fertile oases in the valley below in that it has no fruit trees, producing only grain and a few vegetables. It belongs to the Tippur slope rather than to that of the Chogo Lungma. It may be an alluvial fan washed out at some distant period from the Tippur nala, its upper portion having since been covered with high moraines by the Tippur glacier; but it seems more likely to be the termination of the talus sloping down from the mountain, which forms the opening wall of the Tippur nala on the west. This talus is continuous with the Arandu terrace, and, for several hundred yards above it, is covered with grass and other vegetation.

The Tippur glacier comes down through the gorge between precipitous rock-mountains high above Arandu and extends its sérac-covered tongue to within 1,846 feet of the village. It has evidently been advancing for several if not many years, for it has built entirely around the part outside the gorge a high and massive terminal moraine, above which the ice towers from fifty to a hundred feet, and against which it crowds, overhanging it
TONGUES OF TIPPUR AND CHOGO LUNGMA. 171

in many places. At the extreme end and at one other point the ice has broken over its moraine barrier, and a line of séracs projects half-way down the side of the latter.

The top of the moraine at the nearest point to the village is 415 feet above the latter. The glacier is adding to the moraine at a rapid rate, discharging upon it constant showers of boulders, rocks, and sand, with a thunder which resounds through the air day and night. In short, this glacier may be considered, at present, to be in an aggressive mood. Formerly it reached considerably farther down the valley than now, its old terminal moraine being covered with a thick growth of grass, shrubs, willows, and tamarisks.

On the contrary, the tongue of the far larger Chogo Lungma comes down its valley without fuss or noise to within 1,184 feet of Arandu, where, on a level with the latter, shelving away to a thin edge, it dies out like a spent wave almost imperceptibly on the river-bed.

The Chogo Lungma glacier runs a winding course nearly north of west from Arandu for a distance of thirty miles to its source in a col nearly 20,000 feet high. In these thirty miles it rises from a height of 9,500 feet at Arandu to 19,000 at the base of the col. Its width varies from about a mile at its lower end to over two miles at its upper-middle portion. For convenience of description it may be divided into three sections, according to the distinguishing characteristics of each.

The first or lowest section extends from the end of the tongue nine miles upward to a point above the first bend. The surface of this section is broken up into a confused mass of pointed hillocks, highest along the median line, sharp ridges, and deep ravines. It is so thickly covered with mud, sand, granite, conglomerate, and shaly detritus of every size from small fragments to huge boulders and slabs, that ice is scarcely seen, and where it does appear it is black and smutty. Placed suddenly
upon it, one could imagine oneself in a desert of torn and splintered rock rather than on a glacier.

What becomes of the immense mass of débris that covers this section to its very end, it is difficult to conjecture. One might suppose that its accumulation would long ago have blocked the wide valley below with a wall hundreds of feet high, and buried the village of Arandu deep out of sight; but little evidence of such accumulation is seen, and the fair fields of Arandu still lift their luxuriant burden of grain to the breezes unharmed by the threatening monster above. There is no terminal moraine worth mention, only a few insignificant stone-heaps, just beyond the edge of the tongue, left by the receding ice—a great contrast to the huge moraine enveloping the tongue of the neighbouring Tippur glacier.

Mr. Douglas Freshfield suggests that “the absence or rarity
ABSENCE OF TERMINAL MORAINES.

of great terminal moraines may best be accounted for by the action of floods in carrying away all but the heaviest blocks” (see the Geographical Journal for March, 1905, p. 267, comment 3). In the present case the conditions at the lower end of the Chogo Lungma do not bear out this view. There are no large blocks nor boulders to be seen on the river bed between the tongue and Arandu. Moreover, had a large moraine existed at any time before the recession of the tongue, or been formed during that process, to remove it would have required the action of a powerful flood descending the Chogo Lungma valley on both sides of the glacier or completely covering the latter, or of one almost as great poured out from the Tippur gorge against the tongue itself; in either of which contingencies the Arandu terrace, elevated but a few feet above the river bed and lying directly in the path of either flood, must have been swept away bodily. Floods, even of moderate dimensions, leave their scars upon a landscape. No traces of any flood in recent times are to be found on the Arandu terrace, the cultivated fields of which slope upward to the mountain directly in front of the Tippur gorge. Further, it is not necessary to account for the absence of terminal moraines by supposing that they have existed and been carried away by floods, for glacial tongues do not, by any means, always build large terminal moraines, even when advancing, and when receding, as the tongue of the Chogo Lungma appears to have been doing since 1862, they seldom, if ever, do.

The tongue itself projects from the glacier-bed between the mountains like a gigantic whale, its naked, sloping, glistening, black flank at first over two hundred feet high, tapering down to a small point. Some distance up on its side, near where it leaves the right lateral moraine, a good-sized river flows out from under it, which follows its edge nearly to its end, and then turns across the stone-strewn interval towards Arandu, beyond which it joins the stream coming down on the opposite side from the Kero Lungma to form the Basha river.
This section of the glacier has dwindled greatly from its former volume. Colonel Godwin Austin says that in 1862 the ice was encroaching on the Arandu terrace. Now it nowhere touches it, and has receded to a point 1,184 feet west of the village. The signs of recession below the end of the tongue are so faint that one could not judge from them that more than a slight diminution in its actual length has occurred in recent years, but immediately one ascends the glacier the evidence is more pronounced. A quarter of a mile above the end the side of the tongue has receded more than two hundred feet from the high right lateral moraine.

On account of the broken and crevassed surface of the lower section of the glacier, and the steepness of the mountain-walls on the right bank, the only way to ascend it is to cross over it from Arandu to the left bank, and for the next fourteen miles follow the detritus-strewn space between the former lateral moraines and the present ones. Here the recession is very marked. The ice now lies at distances of fifty to six hundred feet from the original bank, consisting of the mountain-flanks, which are banded by large primary moraines.

Between these and the moraines adjacent to the ice is a system of more or less parallel secondary moraines, separated from one another by considerable intervals. At one place six parallel moraines of this kind were counted. From these it may be inferred (1) that the shrinkage has been going on for a long time, as is shown by the fact that the primary and some of the secondary moraines are covered with vegetation and trees; (2) that there have been periods of arrest in this process, when the glacier was stationary or slightly advancing, during which the secondary moraines were formed; (3) that the glacier is still retreating, as the ice slants sharply back, and in some places has melted entirely away from the moraines last formed.

Just below the upper end of this section a well-marked
TONGUE OF CHOGO LUNGMA. CULTIVATED FIELDS OF ARANDU IN FOREGROUND.
moraine rises on the shoulder of a mountain-spur more than a hundred feet above the ice opposite. To build this moraine the surface of the glacier must have been from a hundred and fifty to two hundred feet higher than at present. This represents an important diminution of the glacier in thickness as well as in width. At no point in this section was it advancing or crowding its left lateral moraines, but everywhere receding from them.

At one place in the lower part of the second section, for a distance of more than 1,500 feet, the ice, which in 1902 had receded from the lateral moraine, in 1903 was pressing hard against and overlapping it, owing doubtless to the increased thrust of a large branch opposite sent down from the Haramosh range. The great accumulation of snow in the reservoir of this branch.
ICE-BOUND HEIGHTS OF THE MUSTAGH.

during the stormy winter and spring had evidently caused a more than usually rapid advance of its whole trunk, with sufficient force to push the Chogo Lungma bodily over to the opposite side.

At some points the lateral moraines are high and massive, at others small. The height of one was measured at a hundred and fifteen feet on the shorter side next the mountain, and others must have been a hundred and fifty feet or more. In several places moraines were being formed along the sides of huge ice-walls, the process being similar to that of the formation of tali at the base of mountain-precipices. In these cases the débris near the edge of the glacier being set free by the melting of the ice, and, falling down the sloping side, accumulated as moraines at the base. These moraines, though not very large, were of typical shape, and there was no evidence...
that their formation was in any degree due to the pressing out of the ground moraine-material from beneath the glacier.

Here and there along the left bank of the first and second sections examples occur of the sand, grass, flower or bush-covered maidans often seen at the sides of Himalayan glaciers. These are level or gently inclined meadows lying between the mountain slopes and the lateral moraines. They are found at places where the slopes recede from the glacial bed, at the entrance of side-valleys, and at the confluence of glaciers, where the lateral pressure is not great enough to force the glaciers against the mountain-walls. The enclosing moraine-barriers usually run in a straight line, except at the junction of glaciers, where pressure may cause them to be formed in a curve.

The maidans are, as a rule, free from stones, and, if at the entrance of side-valleys, may have small clear streams running through them, hence they make safe and convenient places for camps. In those we have examined no moraine-deposits have been found on the mountain-slopes at the foot of which they lie, and which themselves are often covered with grass and flowers continuous with those of the maidan. Nor has such deposit been found upon or in the rich alluvial surface of many of the maidans or the sandy surface of others. The first evidence of moraine deposition is seen in the sharply-defined enclosing moraines, which overlie the maidan-surface as extraneous structures.

These facts, together with the important one that the maidans may be covered with a luxuriant growth of grass, flowers, or bushes, while the enclosing moraines may be destitute of any vegetation, point to the conclusion that the maidans were formed like any other terraces at a time antecedent to the formation of the moraines, and that the latter were superimposed on their edges at a later period, probably curtailing their area to a considerable extent. These maidans must not
be confounded with the spaces strewn with rock-debris lying between primary and secondary lateral moraines.

The second section extends upward for thirteen miles to a mountain wall above the entrance of the Haramosh glacier, where the Chogo Lungma makes a short turn to the south-west. This may be called the section of medial moraines, of which there are six well-marked ones, some of the larger presenting several distinct ridges, which, if counted as separate moraines, would swell the number to between fifteen and twenty.

At the beginning of this section white ice first appears in the shape of a vast white tongue extending downward from above along the middle of the glacier. This is flanked by dark medial moraine-bands bearing the detritus already mentioned.
Opposite the peak Kupultung Kung, owing to some cause which is not apparent, the moraines, which in places rise from sixty to a hundred and fifty feet above the white ice, sink to the general level and lose their identity, joining together to form the chaotic structure seen lower down, the white ice disappearing from view.

As the glacier is ascended, two bands of white ice appear, separated by a huge moraine, the second originating in the Haramosh glacier, the largest branch of the Chogo Lungma. Throughout the second section the edges of the glacier are much broken and crevassed, owing to the entrance of branch-glaciers on both sides, the crevasses being comparatively short and running in various directions according to the pressure. To find one's way from the bank through the labyrinth of resulting séracs to the white ice in the middle requires considerable mountaineering skill. But once gained, the latter being smooth and free from large crevasses, affords a safe passage to the end of the section.

The bend of the glacier to the south-west forms a good-sized basin, into which open five large feeders of the great stream, bearing somewhat the relation to it that the spread fingers do to the palm of the hand. Four of these we explored to their sources.

The large Haramosh glacier sweeps down nearly at a right angle upon the Chogo Lungma, with a thrust so great that the latter is pushed over towards its left bank, and the Haramosh turns to the right in a wide curve and crowds itself in on the right of the main stream, forming thenceforth nearly half the width of the glacier and preserving its identity to the middle of the second section.

The detritus borne along on the left edge of the Haramosh glacier forms at the line of junction with the Chogo Lungma a large moraine in the middle of the glacier, which is pushed high up above the surrounding level by the lateral pressure of
the two streams. Where the glaciers first come together the moraine is not very pronounced, but it becomes more so as they descend. The granite of which it is composed has a reddish colour from the iron it contains. About a mile below the junction of the two glaciers another medial moraine of black débris springs up by the side of the former without traceable origin, and, after a short distance, increases in size and height, rising a hundred and fifty feet or more from the general level, until it quite overshadows the Haramosh moraine, though it nowhere reaches more than half the width of the latter.

It is cleft by enormous transverse crevasses. Below the Bolucho branch these two moraines coalesce and present a uniform dark colour, sinking nearly to the level of the white ice. The detritus on the right side of the Haramosh glacier with that from the tributaries below forms a wide, right medial moraine-belt with several moraines, while that from the left side of the basin and left tributaries forms a left medial moraine much narrower than the belt on the right. The greater part of the detritus of the left moraine appears to be cast out on the side to form, or help to form, the giant lateral moraines there seen, but sufficient is left, with that of the right central ones, to conceal the ice of the lowest section entirely from view.

The medial moraines mark the course of the ice-currents caused by the entrance of tributary-glaciers and the conformation of the bed of the main stream. These currents are complicated, and much time would be necessary to determine their course. Above Riffel promontory one black moraine originating under a mountain on the right bank pushes diagonally across the glacier some three miles, and joins the left latero-medial moraine.

The third section of the Chogo Lungma comprises the remaining nine miles to the col. In this distance the glacier
reservoir of Chogo Lungma. 185

rises 5,000 feet, from 14,000 to 19,000, and is walled in by impressive mountains from 21,000 to 24,500 feet high, whose ice-clad sides rise sharply from it. Here moraines and rock-debris cease to be prominent, their place being taken by a broken surface of séracs and ice-falls, and higher up by névé and driven snow. The séracs begin at Riffel promontory and continue for about a mile, spreading half-way across the glacier. They are largest and most broken near the right bank. Two other series occur above, the first rising so steeply as to constitute an ice-fall. Wide crevasses of unmeasured depth exist over the whole of this portion, in some places in great numbers, in others more scattered. These crevasses do not run transversely from bank to bank, as at one place on the Biafo glacier, but take every direction, often ending in huge ice-caverns. This indicates irregularity of the glacial-bed.

This is the reservoir or formative basin of the glacier, an elevated, savage wilderness of ice, rock, and snow. Here the snow collects with every storm throughout the year, till it lies many feet deep on the solid ice beneath, to which it freezes and whose volume it helps to swell. Large hanging glaciers pour down their ice-contingent in tumultuous confusion to add to the masses below, while the precipitous mountain-flanks hurl down snow and ice-avalanches of enormous size, with a force which causes the earth to tremble and a thunder which is heard for miles. Avalanches here are constantly falling, and constitute an element of danger which has to be reckoned with in every move that is made.

The last five miles of this section consist of a series of vast rounded ice-hillocks, slanting sharply up to the mountains at the sides and rising steeply over one another, their surfaces broken with yawning ice-caverns and deeply covered with snow. At the top, above all, rises a massive ice-wall, its continuity broken by bergschrunds and ice-falls, which culminates in a col nearly 20,000 feet above sea-level.
The Chogo Lungma has fourteen glacial branches, some of which have been and others will be described. The northern branches of the middle section have receded greatly, two large ones, the Bolucho and Kilwaru, no longer connecting with the main stream, and several former branches having entirely disappeared; while the southern branches, apparently, are not receding.

Opposite Riffel promontory a large depression occurs in the body of the glacier a short distance above the line of junction of the Haramosh with it, at an altitude of about 13,700 feet. In the centre of this depression there is a good-sized lake several hundred feet long, of irregular shape, enclosed by perpendicular ice-walls and with streams running into and out of it. This presented the same appearance in 1903 as in 1902, and will probably continue to exist till the movement of the
BIRD'S-EYE-VIEW OF RIFFEL CAMP. SÉRACS AND ICE-LAKE FROM RIFFELHORN.
GLACIER HERE TWO MILES WIDE.
GLACIAL LAKES.

Glacier or some other cause opens an outlet in its bed. A mile north of this, opposite the entrance of Moraine glacier, was a border lake, and two and a quarter miles east of this, at the entrance of an unnamed glacier, three small surface-lakes. No lakes were seen on any of the branches, except on Basin glacier in 1903, where a number of small surface-lakes or water-pools were met with.

At various places along the left or north bank of the Chogo Lungma border-lakes have evidently existed which have been drained dry. Drew mentions having seen one at the time of his visit. At Last Wood Camp, situated behind the stretch of moraine against which the ice was mentioned to be pressing in 1903, we witnessed the process of emptying of a sub-glacial lake, enclosed by the moraine and the ice towering above it. The lake was fed by sub-glacial streams, the ice covering it being much broken.

Late in the afternoon, when the lake became filled to the upper edge of the moraine, water began to flow over the latter in two small rivulets, which, washing out the finer particles of detritus, soon cut channels into its substance. These channels gradually increased in width and depth, until at last two large sluices were discharging an ever-increasing amount of water from the reservoir behind, which about midnight became emptied, or, at least, so far reduced in volume that no more water flowed from it. The discharge was so well graduated that the natural streams below took care of the water without any great increase of volume.

In 1899 we found only one lake on the Biafo glacier, a border-lake about a hundred and fifty feet long, on its western edge, three-quarters of a mile above the tongue. At its upper end, where the Biafo widens out into Snow Lake, we encountered a surface sheet of water, some four inches deep, through which we waded for three miles. Much more water was met with on the Biafo than on the Chogo Lungma, running in streams,
some of them large, which cut deep channels in the ice and finally plunged into crevasses or caverns, to be seen no more.

The Chogo Lungma rises more sharply than the Biafo, and to an altitude more than 3,000 feet higher. Its upper third is much more arctic in character, and melting does not take place to nearly the same degree. Its surface is so broken and fissured that there is not the same chance as on the Biafo for streams to form. What streams there were were chiefly in the middle or second section. The upper third was free from running water for two reasons:—(1) The part from 14,000 to 16,000 feet was so broken that all surface water ran directly down into the crevasses; (2) Above 16,000 feet, where soft snow began, no water was seen in sufficient quantity to form streams. But little water flows on a glacier above the snow line, the soft snow absorbing and retaining any that may be formed by melting, which is again frozen as soon as the sun sets. Such water as does result from the sun's heat thus assists in converting the soft snow into névé and true glacial ice. Shade temperatures, even if considerably above freezing, count for little as a factor in converting ice into water on the higher parts of a glacier as opposed to the cold contained in the ice itself. The chief agent in this process is the direct heat of the sun.

Many pockets were found in the ice, at altitudes of 14,000 to 16,000 feet, from six inches to two feet in diameter and from one to three feet deep, filled with water of crystal-clearness, which furnished excellent reservoirs from which to fill our water flasks. At the bottom of each was a flat stone or a quantity of fine, dark-coloured detritus, suggesting that the pockets are formed by the melting of the ice beneath the stone or detritus by the heat absorbed by the latter from the sun's rays.

Measurements were made by Mr. Hewett at two stations to determine the movements of the glacier. The first station was
REMARKS OF THE MUSTAGH.

...deep channels in the ice...of caverns, to be seen...supply than the Biafo, and...higher. Its upper third is...and melting does not take place...surface is so broken and fissured...mance as on the Biafo; for streams...were chiefly in the middle...upper third was free from running...The part from 14,000 to 16,000 feet...water: it directly down into the...soft snow began, no...tendency to form streams. But...above the snow line, the soft...mighy that may be formed by melting...soon as the sun sets. Such water...water thus assists in converting the...true glacial ice. Shade temperatures,...above freezing, count for little as a factor...water on the higher parts of a glacier as...and contained in the ice.[...]. The chief agent...the direct heat of...sets were found in the altitudes of 14,000 to...a, from six to twelve feet in diameter and from...three feet deep and...water of crystal-clearness, were furnished by...ours from which to fill our...barrels, as...each was a flat stone or a...covered detritus, suggesting that the...melting of the ice...heat absorbed by the...from the...stations to...elements of...first station was
Fanny Bullock Workman
on the north bank, fifteen miles above the tongue. The movement in twenty-four hours—

At a point 1,583 feet from the station was found to be 1'59 feet.

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The second station was on the south bank, three miles higher, just below the entrance of Haramosh glacier. The movement here in twenty-four hours—

At a point 1,302 feet from the station was found to be 1'40 feet.

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These observations were not carried sufficiently far to permit of any extended deductions being made from them. They show that, at certain points on two lines running transversely across the glacier, the ice was moving at different rates, varying from 511 to 1,153 feet per annum, which indicated the existence of different ice-currents moving at different speeds. How far the speed observed for a given point would be preserved is uncertain. Could the same points be identified farther up or down the glacier probably their rates of movement, both actual and relative, would be found quite different from those observed.

The first set of figures are so irregular among themselves that no conclusion as to the movement of the glacier as a whole can be drawn from them. Probably some, if not all, of these currents corresponded with the ice-streams contributed by the branches to form the main trunk, which often preserve their identity for a long distance. The velocity with which these streams move would be determined by the action of
several forces, that are difficult to estimate, and would act unequally at different points, viz., pressure from above on each column in its own axis, lateral pressure of each column on its neighbours, and the force of gravity modified by the nature and direction of the bed beneath.

On the contrary, the points on the upper or second line have an increasing rate of movement from the station towards the centre of the glacier, showing that they were moving on the radius of a curve, which represents just what was happening, the station being situated where the Haramosh glacier sweeps around in a great curve to force itself in on the right of the Chogo Lungma.

The tree growth in the Chogo Lungma nala is scanty, consisting chiefly of willows and cedars, and those are found only on the north or left side. Willows cease at a height of about 11,600 feet, while cedars are scattered over the mountain slopes to about 12,800 feet. We found, cut up, and used for fuel many cedar trunks, which had lain prostrate for an unknown period, larger than those of most of the trees now growing.

Besides trees there is a species of bush, the name of which we did not learn, which is found to an altitude of 14,400 feet, though stunted above 13,000 feet. This at its best attains a height of 10 to 12 feet. Its wood is hard, and it makes a much better fuel than willows and cedars. Grass and some Alpine flora are found to about 15,000 feet in favoured spots. Above this is the domain of rock and ice.

The determination of the snow-line is difficult in a region like that around the Chogo Lungma, split up, as it is, into irregular, ragged, towering peaks and deep tortuous valleys. Many of the mountains far above the snow-line have such sharp slants and perpendicular faces that snow will not lodge on them, and these remain bare of snow at all times, while snow accumulates in their ravines at comparatively low altitudes to such an extent that the heat of half a dozen summers would
not melt it. Snow-beds of this character are not infrequently seen lying exposed to the sun throughout the summer as low as 12,000 feet.

Glaciers, deep snow-beds, and perpendicular rock-faces have to be eliminated from the problem, and its solution sought on even regular slopes, where the depth of snow represents the average snow-fall. Such slopes near the snow-line are not easily found on the Chogo Lungma. But where they do exist, the snow-line varies with the exposure, being higher on southern than on northern slopes, and it also must vary with the character of the season, being considerably lower after severe winters with great snow-fall and in cold, stormy summers, when snow covers the hills during every storm to points far below the actual snow-line. The snow-line is highest about the end of August.

In August, 1902, in ascending the south side of a mountain of 17,814 feet, with a broad, snow-capped top, we first encountered snow at 17,400 feet. The north side of this mountain was covered with snow as low as 16,000 feet. On another peak, not far from the Chogo Lungma, of 17,600 feet, we found in July no snow, except in small patches, till the top was reached, and then only on the north slope, where it extended downward in a large snow-field. On the same dates in 1903, after a severe winter and stormy spring, both these peaks were snow-covered on their south sides for a distance of 1,500 feet below their summits. The snow-line must therefore be considered indeterminate, varying according to exposure, weather, and temperature from about 16,000 to 17,500 feet or over.

As to snow on glaciers, on the Chogo Lungma and its larger branches, soft snow began to be met with at about 15,500 feet in August, growing deeper with increasing altitude. Much of this was new snow from the repeated summer monsoon-storms, and it was impossible to judge of the quantity that might have
existed had the season been more favourable, but its lower limit would certainly be considerably higher in a pleasant season.

Our thanks are due to Mr. John S. Flett, of the Geological Survey and Museum, Jermyn Street, London, who kindly examined a dozen specimens of rocks brought from the Chogo Lungma region, and reported as follows:—

No 1. Granular crystalline limestone with grains of dark green augite ("coccoelite") and veins of quartz and yellow epidote.

Nos. 2 and 3. Granular crystalline white dolomites. They have a close resemblance to marble, but prove to contain much carbonate of magnesia.

No. 4. Hornblende schist.

Nos. 5 and 6. Garnetiferous mica schists.

Nos. 7 and 8. These are hornblende granulites, which contain dark green blades of hornblende and small red garnets in a finely granulitic matrix of quartz.

No. 9. Quartz and chlorite.

No. 10. Grey limestone and green actinolite.

No. 11. Granular crystalline limestone with green chlorite.

No. 12. Hornfils with divergent surface-markings which have some resemblance to fossil plants, but are really a kind of concretions or knots produced by the action of hot intrusions of granite or other similar rocks on impure masses of shale around them.
CHAPTER IX.


In May, 1903, we returned to Srinagar, where on the 20th we were joined by the well-known exploring guides, Joseph Petigax and Cyprien Savoye, of Courmayeur, and Laurent Petigax fils as porter. These guides, whose efficiency as experts in snow and ice-craft it gives us pleasure to recognise, were engaged and sent out to Kashmir by the kindness of Signore Francesco Gonella, then President of the Turin Section of the Italian Alpine Club, and Signore Ettore Canzio, of Turin, to whom we are greatly indebted for their prompt and friendly assistance. A few days later Mr. B. H. M. Hewett, of London, who was engaged to accompany the expedition as topographer, arrived.

Four years previously, when ascending the Biafo glacier, being impressed with the character of the peaks seen to the west of it, and persuaded that the region lying between the Biafo, Hispar, and Chogo Lungma glaciers would prove worth investigating, we determined to explore it should opportunity offer. The present seemed a fitting time to carry out this plan, so we left Srinagar on 26th May with the intention of making the Hoh Lumba, the nearest glacier west of the Biafo, our objective.

The march to Skardo, as in 1902, was made by the Indus valley route, and that village was reached on 8th June. Here
we met the Kashmir Joint Commissioner for Ladakh and Baltistan, who had been promoted to this position from that of Tehsildar at Skardo, which he held in 1902. He arranged for our entertainment a polo game, in which the Raja of Skardo and his four brothers took an active part. We were impressed not only by the equestrian skill of the players, but also by the agility of the small mountain ponies, and the clouds of dust they raised in scurrying over the ground. Polo was followed by a weird slow nautch performed by mountain men from a remote nala, during which the Raja’s band played its loudest strains. Amusements at Skardo are of a simple character, in keeping with its primitive civilisation and rugged environment.

Not having found the Basha coolies wholly satisfactory the preceding summer, and with a view to avoid some of the
RAJA OF SKARDO, THREE BROTHERS, AND PIPE-BEARER.
difficulties then experienced, we decided to try to get thirty
picked men at extra wages, who would agree to go with us for
the summer, to form the nucleus of a transport corps, on which
some reliance might be placed. On the march from Dasso to
Rondu the preceding September, we had a set of fine large
fellows, who shouldered their loads as if they were of no
account, and strode ahead up the hills so fast that we could
scarcely keep pace with them. These were the men we sug-
gested as the material from which to select the picked corps
desired.

The Resident of Kashmir, with the consent of the State
authorities, kindly requested the Skardo Tehsildar to have thirty
coolies from this district meet us at Skardo. When we arrived
they were waiting for us, but they were not men of the stature
or calibre of those whose work had been so satisfactory the
season before. They were undersized and unprepossessing
in appearance, and were collected from villages other than
Dasso.

As time was of value, and we could not wait to have others
got together, we decided with many misgivings to try them.
After the Tehsildar had spent the better part of two days
haggling with them, they finally agreed for double the customary
wages and their food to go with us for the season wherever we
wished, and to forfeit half a month's pay in case they broke
their contract. A contract in writing was then drawn up by
the Tehsildar, their names all inscribed under it, it was read to
them, and each put his thumb mark opposite his name, the whole
being duly witnessed. Half a month's wages was then advanced
to them, the other half to be paid at the end of the month, and
they entered our service.

The first march to Shigar showed their animus. Seizing the
lightest loads they could secure they loitered and dragged com-
plainingly along, reaching Shigar two hours and a half after the
local coolies, a serious handicap, when we needed our kit to
pitch camp with. This continued for two weeks, when, having camped for four days on snow, and in a measure become accustomed to it, they came in a body to our tents, declared they would leave, and demanded payment for the remainder of the month. They then left, much to our relief, for their influence on the other coolies was pernicious. So failed an attempt to secure faithful service from coolies by large wages and written contract.

During the week from 10th to 17th June the sun-temperatures in this region were unusually high. Some of them were—

June 10th.—Skardo, 1 p.m., sun 201° F., shade 80°; 4 p.m., sun 180°, shade 76°.

June 12th.—Camp three miles from Shigar, altitude 8,000 feet; 1 p.m., sun 195°, shade 82°.

June 13th.—Same place, 12 noon, sun 198°, shade 81°; 1 p.m., sun 202°, shade 83°; 1.30 p.m., sun 203.8°, shade 86°

June 14th.—Same place, 12 noon, sun 201°, shade 76°; 12.25 p.m., sun 206°.

June 15th.—Same place, 1 p.m., sun 198°, shade 76°.

These figures speak for themselves. No sun-temperatures during the summer in the plains of India approached them. This subject will be referred to later.

After leaving the Shigar valley we turned eastward around the base of Buspar into the Balsdoh valley, and, crossing the Balsdoh river on a zak, marched up the valley twelve miles to the village of Hoh, which lies at the entrance of the Hoh nala at an altitude of 9,165 feet. Here on 18th June the caravan was reinforced by Hoh coolies and a lamberdar, which brought the total number up to seventy. The next day, leaving a munshi from Srinagar to look after our interests at Hoh, we started to ascend the Hoh nala, taking as livestock sixteen goats and eleven sheep in charge of a goatherd, and a good supply of fowls, which were carried by the coolies.

A narrow, rough path, rather difficult to follow, here and
THUMB MARK SIGNATURES OF COOLIES TO CONTRACT.
there interrupted by fallen rocks, winds upwards in the nala along the precipitous flanks of nude mountains overhanging this confined gorge, through which the noisy, khaki-coloured Hoh torrent fights its tortuous way over and around huge boulders with hissing roar, gullyling through clay and sand-banks, bent on forcing its rapid course to the more placid Braldoh below.

The nala is filled with old glacial débris several hundred feet deep containing many boulders large and small, through which the torrent has cut its way. After running for some distance high above the river, the path finally descends to it. At this point the bottom of the nala was choked by a large winter-avalanche, its snow mingled with trees and black detritus, which completely covered the river, that had tunneled a channel through it. This passed, the path skirted upward again, in places losing itself in angry side-torrents, over which we leaped as best we could. At one spot a few white birches and burtsa-tufts were struggling for existence on the arid flank. Otherwise the nala was devoid of vegetation, grim and lifeless, without a note of colour. Some call Ladakh routes dull and monotonous, but that land is full of ever-changing beauty and picturesqueness compared with the vale of the Hoh, held, as it is, in the acme of desolation.

Four miles above Hoh is Pirnar Tapsa, a small grazing-ground shaded by a few birches and cedars. Beyond this the narrow trail ascends again into desolation. But consolations come to those who seek long enough for them in Himalaya, as we found, when, rounding a bend of the barren mountain, we emerged on a wide green maidan dotted with trees, among which cattle were grazing or drinking at musical rivulets. This was Nangma Tapsa, at 11,590 feet, nearly 2,500 feet above Hoh. Here camp was pitched directly in front of the tongue of the Hoh Lumba glacier.

Rain and snow fell that night, and it snowed till nearly noon of the 20th, showing how true were the reports of the late
winter in the mountains. As this was the last camp at which wood could be obtained—indeed every camp above this was to be on snow—we occupied the coolies on this day in carrying wood a thousand feet up the mountain-side for use at higher camps. The limit of wood-growth here is at about 12,000 feet.

Above Nangma Tapsa, between it and the glacier, is a hill above five hundred feet high extending across the space from mountain to mountain. Examination shows this to consist entirely of moraine-material, and to be in fact the giant terminal moraine of the Hoh Lumba. This moraine is interesting in several ways (1) on account of its great size, being not only some five hundred feet high, but at least half a mile wide, and over half a mile in depth from its front face. It is the largest terminal moraine we have anywhere seen, the Hoh Lumba distinguishing itself from the far larger and longer Chogo Lungma, which has no terminal moraine at all, by building one of this size. From what we were able to observe on the snow-covered glacier above, it would appear that it brings down nearly the whole of its débris to be excreted at its end, leaving comparatively little for the formation of lateral moraines higher up.

(2) On account of its age. The greater part of it is covered by a growth of rather large cedars, showing that it must have existed to almost its present extent for a very long time. The tongue of the glacier has evidently been slowly retreating, probably for centuries, piling up this monumental moraine as it went. The lower moraines behind it, running back another half mile to the ice, are of more recent formation. These are destitute of vegetation, except where they join the older part, where there is some small scrub.

(3) On account of its formation. It will be noticed in the illustration, that the moraine-hillock is divided into two portions separated by a furrow, and that these two portions correspond to two ice-streams above, also separated by a furrow, which is
continuous with that dividing the hillock. It is therefore evident that the two portions of the hillock were formed by the two ice-streams composing the glacier, which have preserved their separate identity during all these ages. Four miles above the present tongue of the glacier two glaciers of almost equal size and length come together to form the main trunk of the Hoh Lumba, and the two ice-streams thence derived move
downward side by side without actual union, and deposit in one spot at the end moraine-detritus gathered from two entirely distinct basins.

On 21st June we started to explore the glacier. To reach it we ascended the steep hillside above its right bank for about a thousand feet. The shoulder of the hill is crowned by a massive, but not very long, stretch of lateral moraine rising fully a hundred feet above the slant on which it stands. Resting squarely on the top of this moraine is an extraordinarily large granite boulder, the form and dimensions of which are represented by a cube with a side of fifty feet. A short distance from it is another not much smaller. We judge these boulders were brought down upon the surface of the glacier and deposited in their present position after the moraine was formed, as their angles and edges are not rounded off and their surfaces do not show markings from friction, as might be expected had they been transported in the glacial bed and been extruded upon the moraine by pressure. Moreover, had boulders of such size been pressed out from beneath the glacier they would have made deep channels in the side of the moraine in reaching their present position, and would have been somewhat deeply embedded in the moraine itself, neither of which effects are apparent, the boulders standing on comparatively narrow bases on the sky-line of the moraine. Surely Titanic forces must have been at work to have deposited such mementoes of Nature's power in this position.

From the ridge of this moraine a good view is obtained of the glacial tongue below and of the glacier itself for a distance of several miles. It was easy to see that the glacier has receded not only in length, as shown by the hillock and the moraines behind it, but also in width, as the moraine itself most conclusively testifies. Its top is fifty feet or more above the present height of the ice, which also has shrunk a considerable distance away from it. To have built this moraine, and especially to
ANCIENT TERMINAL MORAIN, HOH LUMBA, DIVIDED IN CENTRE BY FURROW, WHICH CAN BE TRACED FROM IT UP THE GLACIER.
have deposited such huge masses of rock on its top, the ice must have crowded upon and towered a good deal above it. The side of the glacier also is now separated by quite a wide interval from the smooth and rounded surface-rocks below the moraine, though there is no reason to doubt that the ice formerly reached to and partially covered them. We found no striation marks upon them, but this is not surprising, as such, if they ever existed, would have been effaced long ago by the weathering they have undergone. Several small moraines between these rocks and the side of the tongue show the periods of recession at this point. The stream flowing from the glacier being turned aside by the high terminal moraine has cut its way through the interval between it and the mountain.

Before leaving the moraine we took counsel with map and
compass regarding a problem which confronted us. Some three miles above, at the base of a mountain promontory, the main glacier was seen to divide into two equally large branches, which ascended in different directions. This was quite a
SNOW-HILLOCK CAMP, 14,171 FEET, HOH LUMBA.
different topography from that denoted on the Survey map, which shows one long glacier with side feeders. Which of these branches represented the main glacier? Having finally decided to follow up first the left-hand one, which corresponded most nearly with the direction of the long glacier laid down on the Survey sheet, we descended to the ice.

Before doing so, as it was evident that the further journey would be through a snow-bound region, the goats and sheep were sent back to Nangma Tapsa, the latter to be killed and forwarded as needed. The only animal we saw that seemed adapted to this environment was the ibex, numbers of which were feeding on the few bare spots of the mountain-sides. Late winter, as well as newly-fallen snow covered everything, the glacier with its séracs, crevasses, and moraines, and the lower mountain spurs, where usually in summer patches of earth or uncovered rock-ledges are found for tents, and grass and vegetation for goats and sheep, as high as 14,000 to 15,000 feet. Only a jutting rock broke here and there the deep white mantle that still held the middle mountain world in the sleep of winter.

About half a mile above the moraine we had just left, a large branch a mile wide enters the Hoh Lumba from the west. This sub-divides into three smaller branches, of which the middle one springs from the snows of Mt. Ganchen. The Chaltroro, another branch, enters on the east side just opposite, and again on the west side shortly above, two others, making four branches in all. We marched up the glacier over a succession of large ice-hillocks separated by wide furrows, and about noon reached the point of divergence and struck into the left-hand or west branch leading north-west. Just above the dividing point there was a good-sized lake in the glacier, its surface frozen over and partially covered with snow. The weather now changed. Heavy clouds rolled over the sky, and by three o’clock snow was falling so briskly that we could see
nothing five hundred feet distant. Looking around for a favourable place to camp, we found a flat snow-surface near a glacial water-pool for our tents, and some rocks below to shelter the coolies, who take to rocks as a rat does to a hole.

Here we proceeded to make ourselves as comfortable as circumstances allowed. This was named Snow-Hillock Camp.

On this occasion it was not necessary to melt snow for water. All water buckets were speedily filled, lest the reservoir should freeze over in the lowering temperature. The coolie-tents proved insufficient for the number of coolies, and, much to our regret, we were obliged to loan them one of ours. Loaning a tent to coolies, even for a night, is the ruin of that
ON HOH LUMBA GLACIER THREE MILES BELOW COL DES AIGUILLES AT ITS HEAD.
tent, so far as the further use of it for oneself is concerned, as those who know coolie-humanity can well imagine.

It snowed and blew the greater part of the night, but cleared towards morning. At 6 a.m., when we wished to strike tents, the pegs were frozen hard into the snow, and had to be loosened with an axe. Water in buckets inside the tents was converted into ice, and the glass indicated 10° F. This, though it was only at 14,171 feet, was as cold as we had had it at above 17,000 on the Chogo Lungma in July the preceding summer.

Just above Snow-Hillock Camp the third and last tributary of the west side, the Eree glacier enters the Hoh Lumba. It is something over two miles long, and, when we saw it, presented an unbroken snow-surface, no crevasses being visible. It runs up to a beautiful snow-peak, one of the most conspicuous on the glacier, which was measured by the topographer at 20,859 feet.

By eight o’clock we were again on the march. Bright sunshine ameliorated the temperature, and soon we were glad to discard warm coats and Jaeger caps and replace them by light clothing and topis. The scenery at the camp was magnificent, and increased in grandeur as we ascended. Three miles above this camp the glacier, bending north, widens into an elongated basin, encircled by granite needles, which at that early season, their knife and sword-like forms dashed with fresh snow wherever it could lodge, presented one of the most bizarre and impressive mountain landscapes we have met with. The Grepon, Dent du Geant, or other aiguilles of the Mt. Blanc range, transplanted here would be but the veriest gendarmes of these massive heights, which, rising in giant towers and airy pinnacles, reminded us of the Ogre and Mt. Meru of the Biafo.

Our route wound upwards over high snow-hillocks rising in wavy undulations, which partially concealed from view the splendid peaks ahead, so that their full majesty burst upon us only when the upper part of the glacier was reached. Owing
to the heavy covering of snow it was difficult to judge of the conformation of the glacier, or of its moraines. Lateral moraines, so far as we could judge, were slight or wanting, and medial moraines, if they existed, were so covered with snow that they could not be distinguished.

Good progress was made throughout the morning, the snow remaining hard till one o'clock. As we approached the head of the glacier only one depression in the vast cirque of enclosing mountains could be discovered, a snow-col between two peaks, which overtops a high, much seracked and dangerous-looking ice-fall, and forms the ultimate source of the Hoh Lumba. If we could reach that col a glimpse of the beyond, so alluring to mountaineers in unexplored regions, might be obtained. To reach its base would take the coolies
SPRAY OF PEAKS IN MIST, HOH LUMBA GLACIER.
ON COL DES AIGUILLES, 18,331 FEET, HOH LUMBA.
WAITING FOR COOLIES.

at their waning pace still an hour and a half. We therefore pushed on with the guides, leaving them to follow.

Below the ice-fall, at a point safe from avalanches, we had tiffin and discussed the chances of an ascent the next day. An hour passed and not a coolie appeared in sight; but at length the khansamah and two servants came up, and said the coolies would not come higher, as some were ill and there were neither rocks nor water where we wished to camp. It was indeed an inhospitable place, not a sheltering rock in sight, nor water, only the great snowy expanse stretching below, and the stern, pitiless mountain-sentinels watching above. Still the chances were the khansamah spoke quite as much for himself as for the coolies.

Camp there we must if the col was to be reached the next day, so Dr. Workman and the guides descended to encourage and urge on the coolies. Mrs. Bullock Workman waited with the khansamah and servants, who soon fell asleep in that supreme isolation of snow and rock, where the silence of overawing Nature becomes at moments more oppressive and nerve-straining than a constant booming of artillery. This silence was broken now and then by the roar of an avalanche, which could be seen starting like a snowy rivulet from a sharp slant and increasing in size and force as it rushed downwards, until far below in rolling white masses it crashed upon the glacier, throwing up a mist that filled the air for a long distance.

Here, at the height of Mt. Blanc, at 2 p.m., a sun temperature of 170° F. was taken; not so very high for the altitude, but sufficiently so to make the reflected heat in that enclosed, windless basin oppressive. At last the coolies, having been persuaded to advance, arrived, some of them nearly snow-blind because they would not use the glare-glasses furnished them, others affected with mountain sickness, or pretending to be. When all had deposited their loads, they were set at work to trample down the soft snow to make tent-
terrace. The camp here, established at 15,780 feet altitude, was called Camp des Aiguilles. The sun left the camp at 4 p.m., and by five it was freezing hard, a strange contrast to $170^\circ$ in the sun three hours earlier.

To make a fire in these snow-camps a rough fireplace has to be improvised with at least four good-sized stones. As none were at hand, the coolies having neglected to bring any from below, we had to content ourselves with melting snow for water and heating tinned provisions for dinner over a primus stove. Before turning in at night we called up the shivering khansamah and told him to see to it that a good dinner with hot soup and roast mutton should be ready the next evening when we returned from the mountain above. He grumbled somewhat, saying he could not make a fire. "Send coolies down for stones; there will be plenty of time to-morrow," we replied, tying the tent-flaps against the icy blast. One must not be too lenient with a Kashmiri khansamah, even at snow-camps.

The guides called us at three-thirty, and in an hour we five stood under a starlit sky, with a temperature of $12^\circ$ F., adjusting the rope for the start to the col. We hoped to find a way up the broken ice-fall, but on reaching its base the seracs were found too formidable. We therefore changed our course, skirted a rock-wall to the right, crossed a large bergschrund, and traversed a series of steep ($60^\circ$) snow-covered ice-slants, perched above perpendicular precipices on the abrupt flank of a Cervin-like peak at the right of the col: a route which did not prove much easier to negotiate than the ice-fall would have been. By the time the last of these slants was behind us, and we had reached the upper part of the ice-fall, where there was standing room, we found it necessary to eat, for we were thoroughly chilled notwithstanding the exercise. The cold seemed harder to bear than when we left camp, and the sun would not strike our path for another two hours.
MOUNTAIN-WALL SEPARATING COL DES AIGUILLES FROM HISPAR GLACIER.
After a kola biscuit and some congealed meat, we were off again over the steep slopes leading up to the final one beneath the col. Absolute silence reigned on the rope, broken only by the sharp click of the axe on the frozen surface. On we went, higher and higher, sometimes traversing, sometimes straight up a snow-areté, catching now and again glimpses of our tents poised like flies on the glacier 2,000 feet below. The strain of several hours on the precarious slants was at last relieved, when a small plateau was reached, where a halt was made before attacking the final thousand feet to the top. This last was a trifle less steep, but the heat now became as oppressive as the cold had been earlier in the morning, and we felt the effects of rarefied air somewhat, which some of the party accounted for by the fact that we had come up within a week from the steamy Braldoh valley.

These annoyances were all forgotten when, at ten-thirty, on completing a wearisome slope, we realised that the top of the col was reached. The ascent had occupied six hours. Great peaks loomed ahead from the Hispar side, and we were pushing forward to see them better when Petigax called, "Halte! C'est une corniche." We stopped instantly, realising, as we glanced around, that we were standing on a huge, curling cornice overhanging a terrific precipice. This rounded ice-tongue projected well beyond the mountain-brow, and, having no support, might break away and disappear into the abyss below at any moment, carrying us with it. It is never safe to trust to the strength of a cornice, however massive it may appear, as we had had occasion to note in case of some of the avalanches we had seen.

We moved cautiously back to a point where the snow was firm. Then, held securely by us all, Petigax advanced slowly upon the cornice to where he could look over. Having made his observations, he returned, and the rest of us, each in turn, similarly supported, went out to have a look over this wonderful ice-edge. The sensation was extraordinary. One stood alone
on the glittering shelf, suspended as it were in mid air. In front rose a mighty world of unexplored summits, and some 4,000 feet directly beneath swept a placid glacier, separated from the Hispar by an unbroken granite wall towering at intervals into imposing peaks. Standing on that relentless monster-cornice, where a few steps forward would precipitate one into eternity, was a never-to-be-forgotten experience. As every mountaineer knows, such moments are stupendous, more awesome, yet filled with keener enjoyment than are months of ordinary existence. Truly one lives a hundred years in a moment of such supreme exaltation.

Returning to a safe position, although the wind having risen was blowing half a gale and the temperature was 30° F., we turned our attention to photography, readings, and studying the glorious sweep of the Hoh Lumba and its magnificent peaks. Toward the north, through a notch between two peaks of the wall above mentioned, a snow-pyramid was visible, rising on the north side of the Hispar glacier. This was recognised as one of the peaks we saw and photographed from the Hispar pass in 1899. The glacier running beneath the cornice and discovered from it is a narrow enclosed glacier, originating in a col, which separates it from the Biafo, and ending, probably, beneath the mountains enclosing the Alchori glacier on the east. Its origin in the col was later seen from the head of the Sosbon glacier, but its western end could not be seen from the cornice we were on. If it has an outlet on any large glacier it would be on the Hispar, east of the Alchori glacier. Sir Martin Conway assures us that when he ascended the Hispar he saw no glacier entering it in this region. We named it Cornice glacier. The col was named Col des Aiguilles or Needle Col. Calculations based on the readings give it an altitude of 18,331 feet. Its ascent was of value, in that it settled the question in the negative of a direct passage from the Hoh Lumba to the Hispar glacier, as is shown on the Indian Survey map.
ROCK-AIGUILLES ABOVE CAMP DES AIGUILLES, HOH LUMBA.
DESCENDING HOH LUMBA.

We descended to a lower and more protected place for tiffin. This over, the descent was continued, as the dangerous arêtes and slopes had to be retraversed in the softening snow, and we knew that in the afternoon they would not be safe from avalanches. By constant attention to every movement all went smoothly, even over a place we called "le lit des avalanches," and soon after three o'clock we reached safe snow, and saw our tents assume larger proportions than those of the flies they had represented when we were higher up. On reaching camp, highly satisfied with the day's work, the inner man was appeased by the khansamah's offering of a dinner of soup, roast mutton, and custard pudding, showing that he had after all succeeded in making a fire amid the icy surroundings of the Hoh Lumba.

The ascent had been made just in time, as was so often the case during this and the preceding season. The next day, as we were descending the glacier, the weather changed, and by 9 a.m. all mountains were veiled in cloud, and soon after snow was falling. Reaching the junction of the other large glacier which unites with the Hoh Lumba, we turned into it. This glacier, which the natives called "Sosbon," makes a turn to west and then runs in a curve nearly parallel with the Hoh Lumba.

We followed it up for about three miles, when the storm increased to such an extent as to shut out all view, and we were forced to camp at 15,019 feet. This was Camp Sosbon. It was here that the Dasso coolies, as before mentioned, surrounded our tents in the storm and insisted on leaving. We did not try to detain them, as they had shown themselves so incapable and insubordinate, and we still had forty Hoh coolies, who could get us out should the storm become dangerous. Further, foreseeing this action on their part, we had sent to Askole for others, who were shortly expected. They left, and on their return to Skardo, instead of forfeiting two weeks' wages as per contract,
they tried to sue us through the Tehsildar for half a month's wages not due. This shows how above keeping a business agreement Balti coolies may be, and how unreliable above the snow-line. Contract, high wages, food, tents, tea, and tobacco, all of which were theirs in this case, make no impression, and, after a few days' snow-camping they cease to be the debonair, helpful individuals often depicted by the Anglo-Indian valley pounder.

The next morning we awoke to the fact that we were snow-bound for at least another day. The storm, with now and then a slight break, lasted for forty-eight hours. When it ceased, and the clouds rolled away revealing the deep vault above, we discovered that the spot where Nature had stalled us in one of her fiercest moods was perhaps the most beautiful of the many we had camped at in Himalaya. A long line of vertical aiguilles bounded the glacier below, and above the camp a magnificent snow-mountain with a peculiar curled top peered out of the vanishing mist. It is quite 22,000 feet high. We gave it the name of Mt. Sosbon. It is the striking personality of the glacier. From above, from below, from every part of the glacier it catches the eye and holds it, and even as far away as the Braldoh its snowy top is seen forming a background to the Hoh nala.

After the storm had ceased, allowing a day for the snow to settle somewhat, we ascended the glacier with the guides. Towards its upper end it widens considerably, and, making a bend to the north around the flank of Mt. Sosbon and at last rising sharply, it ends, or begins, in a snow col similar in position to the Col des Aiguilles. The ascent to the col was not difficult, though the snow became waist high before the top was reached. This col, named after the guides, Petigax and Savoye Col, lies at an altitude of 17,000 feet. It is corniced, has a precipice beneath the cornice falling to Cornice glacier, and affords no passage to the Hispar. As already stated, something over a
mile to the east we could see Cornice glacier rising to a col, on the other side of which lay the Biafo slope.

In descending, about four miles below the col, we came upon a slender mass of gneissoid rock, eight feet in diameter by twenty-three high, standing upright near the centre of the glacier, its upper third being split into five distinct fragments, which have kept in place without dislocation. This rock must have fallen from a peak at the head of the glacier, and it is remarkable that it should have landed in the upright position and retained this during all the glacial vicissitudes and the unknown period of time required to transport it to where it now stands.

Owing to the deep covering of snow deposited by this and preceding storms, much that would have been of interest both on this and the Hoh Lumba glacier was concealed from view.
The glacial surface was rigid and undulating, but we saw no séracs, crevasses, nor moraines. Three well-defined, longitudinal ridges extended down the glacier, which probably carry medial moraines. Two circumstances favour the supposition that the glacier bears a large amount of detritus under the snow—(1) the existence at several points of masses of rock, including the one just mentioned, protruding from the snow; and (2) the size of the moraines already excreted and in process of excretion by the tongue. Except for the depth of snow the glacier was easy to ascend.

Some observations were attempted to ascertain the movement of the glacier. These were made with difficulty owing to the depth of surface-snow, the stormy weather, and danger from avalanches on the steep slopes at the sides of the glacier. The only practicable point for making observations was on the west bank of the Hoh Lumba, a short distance below Snow-Hillock Camp, just above its junction with the Sosbon, where the inclination was $2^\circ 32'$ from the horizontal. Here, at 440 feet from the bank, the movement was twenty-six one hundredths foot in twenty-four hours. At 734 feet it was twenty-one hundredths foot. Better results were obtained on the Chogo Lungma.

The length of the Hoh Lumba from the top of the Col des Aiguilles to its junction with the Sosbon is eight and a half miles, that of the Sosbon seven and a half miles. The total length of the Hoh Lumba, assuming this to be the main glacier, is to the present end of the tongue twelve miles. Its width varies from a half to one mile; that of the Sosbon is somewhat less.

Fortunately, by the time we were ready to descend from Camp Sosbon, thirty new coolies arrived from Askole, so that we were able to take all equipment with us. On 29th June, leaving Mr. Hewett on the Sosbon to complete some work, which he was after all unable to finish on account of continued
GNEISSOID ROCK IN FIVE FRAGMENTS STANDING IN CENTRE OF SOSBON GLACIER.
storm and accumulating snow, we returned to Nāngma Tapsa, and on 1st July reached Hoh, having had bad weather during the downward march. The only two fine days during the whole time were those on which the two cols were ascended.

We next proposed to return to Riffel Camp on the Chogo Lungma to complete the survey of the upper part of that glacier and, if possible, to climb one or more of its high peaks. Leaving Hoh on 2nd July, we marched rapidly down the Braldoh valley and over a pass to Thurgo, where we crossed the Basha river on a zak to Chutrun, thence marching up the Basha valley to Arandu, which was reached on 5th July.
CHAPTER X.


We found a hundred and fifty coolies waiting at Arandu, collected from the Basha villages by order of the Government. The day after our arrival these were all marshalled in line near the camp, and we selected eighty-five of them to go with us, and several more to serve as dak-coolies and special messengers. Among those present were a number whom we recognised as fomenters of dissension among the coolies the preceding season. These, although they officiously put themselves forward as volunteers, were promptly relegated to the ranks of the undesirables, and told they might depart at once. The names of those chosen were listed, as was done the preceding summer, and the date of engagement.

Besides the Arandu lambardar several other Basha lambardars were on hand. Not wishing to impose two summers' work on the Arandu lambardar, we proposed that one of the others should assume charge of the coolies, but not one of them was willing to do so. Indeed not one of them appeared to possess the backbone or the moral courage to go on such an expedition. We were therefore thrown back on the Arandu lambardar, who immediately expressed his willingness to assume the responsibility, which he did and performed his part, in the main, to our satisfaction.

Profiting by the experience of the preceding season, we determined to leave nothing to chance in the matter of food for the coolies, but to provide ata for them at our own expense, so
METHODS OF PILFERING GRAIN.

that lack of food might not be urged as an excuse for neglect of duty. When passing through Shigar, the grain centre of this region, we arranged with the Kotwal, who had orders from the Tehsildar to supply us with all the ata needed, to send us the required amounts at regular intervals, for which he was paid in advance. He promised to do this, and to deliver the ata in full weight under seal.

The first lot, which was despatched under our supervision, reached Arandu in proper time, but later, as may always be expected in Kashmir, the service was very irregular, both as to time of delivery and quantity delivered. We never knew when the ata would arrive, and five or seven maunds would be received where twenty-five were expected. Our movements were consequently hampered at times, and failure to deliver promptly nearly caused a famine among the coolies on one occasion. We had several times to send down special messengers to hasten the transport.

The ata was forwarded in skin sacks, most of which were old and rotten, having numerous holes which were insecurely stopped with rags or tufts of wool. These holes, besides permitting of the escape of the ata in a natural manner, furnished convenient channels by which the carriers could supply themselves with food en route. In some of the sacks, otherwise sound, small clean cuts were found near the tied ends, through which the contents had been deftly coaxed out to the amount of several pounds from each. As a result, the ata, if the sacks, which were entirely innocent of seals, were properly filled when despatched, showed a shrinkage of fully twenty per cent. in weight. Some of the sacks were less than half full when received. In other parts of Kashmir, where grain is carried in gunny bags, the coolies insert a small tube or a stick into the meshes of the gunny, and in this manner extract any desired quantity from the bag. When the tube or stick is removed, the fibres of the gunny return to their proper position, leaving no
trace of the place through which the robbery was effected. In
any case the traveller in Kashmir, who provides food for his
coolies, may rely on the disappearance of a substantial portion
of it en route.

We had with us on this expedition two Gurkhas, who were

![Our Gurkhas](image)

procured through the kind assistance of Arthur Grey, Esq., of
Lahore. They had served their time in the army and risen to
the rank of Subadar. We employed them as higher servants,
and gave them a tent to themselves. Being Hindus, they pre-
pared their own food, and held themselves somewhat apart from
the other servants. They carried no loads, and did no climbing
with us, though one of them followed us in charge of supply-
OUR GURKHAS.

coolies to our highest camp at 19,358 feet, and later on over a difficult snow-pass. But they assisted in pitching and striking tents, packing and unpacking, took charge of coolies on the march or when sent on special missions, and themselves acted as messengers on important occasions. They showed themselves reliable, and what they did, did well. They were good-natured and respectful, greeting us in the morning and taking leave at night with a precise military salute. One of them was fond of a joke, and, although small of stature, had a stentorian voice, which appeared to overawe the coolies, as its clarion tone rang out in admonition of loiterers on the march.

We remained at Arandu seven days to complete arrangements, of which the four days from 7th to 10th July inclusive were remarkable as being cloudless, no such interval of fine weather occurring again for a month, when five consecutive days were fine. The remainder of the time till the end of August was stormy, with only an occasional clear day.

On 10th July, Savoye, the lambardar, and thirty coolies, were despatched up the glacier to cut and collect a supply of wood, and on 13th we followed with the remainder of the coolies and kit, including goats, sheep, and fowls. We marched in rain, which continued, with few intermissions, for four days. Even at an altitude of less than 12,000 feet we had to traverse large snow-beds, in places over twenty feet deep, where the previous summer no snow was seen. These were the remains of snow deposited during the severe and late winter. There was also much snow on the glacier for a long distance below Riffel promontory.

Arrived at this last, which in 1902 was free from snow, we found it mostly covered, our old camping ground being buried many feet deep. The only bare spot was on the edge of a sloping shoulder soaked with snow-water, where, a hundred feet above our former camp, we constructed terraces for our tents. Below, on the rock ledge, where the coolie-village of
the previous summer stood, the sun had also melted away
the snow, so that the coolies could soon make themselves at
home.

As we pitched our tents we saw the stone cairn we had built
on the summit of the Riffelhorn, 1,300 feet above, peering
down upon us. Then it disappeared in mist, a mist of fog,
rain, and snow, which was destined to veil the whole mountain-
world for days. Our position was not exactly a protected one
on the exposed shoulder of the mountain, upon which the pre-
vailing west wind swept down with full force from the icy wall
of the Chogo La over nine miles of glacier.

It stormed and stormed, not monotonously, but with all the
variety a turbulent Himalayan bad-weather period can offer.
A night of quietly but steadily accumulating snow would be
followed by a dreary morning of rain. At noon, perhaps, a
break would occur, when the shifting mists would disclose miles
of snow-covered glacier overtopped by virgin peaks half-suc-
ceeding in casting off their burden of cloud, their airy tips
sunshot for a few minutes with golden mauve.

Tantalising moments those, when we forsook tents and paced
the wet slope, seeking warmth in the fugitive gleams of sickly
sunshine, to be driven in again speedily by incoming fog and a
renewed flurry of snow. When the elements were tired of
venting snow and rain on the mountains, they treated us to
wind, from erratic gusts to a steady blow, when the canvas
shook, the tent-cords creaked, and we amused ourselves by
holding the quivering poles as one might cling to the masts of
a sinking ship.

The goats and sheep, which in good weather could find
slender grazing on the small area of stunted grass which had
shaken off the mantle of winter, groped disconsolately about,
nosing out holes in the snow in the attempt to find means of
subsistence. The meals, which the bearer, dripping with sleet
and rain, served, would not have tempted an epicure. Chops
MOUNTAIN STORMS.

were singed and blackened by the smoky flame of the khansamah's unruly fire of wet wood, and the custard pudding was of swimming consistency, because it refused to bake over

the miserable nomad-fireplace. These minor tribulations of high camp-life we cared little about, if the weather would only clear and give us our peaks and glaciers. But it did not immediately, and for nine days the above described conditions
continued. Such were the storms in higher Baltistan, that in
days of ceaseless rain in Kashmir inaugurated the great Srinagar
flood at the end of July.

On 25th July the sky cleared, and the sun once more shed
its warming rays upon us, sending the mercury in the solar
thermometer up to 190° F. at 1 p.m., the shade temperature
rising to 60°. The bright sunshine caused the new snow to
settle considerably. The next morning with twenty coolies and
light tents we started at 6.20 to ascend the Chogo Lungma to
have a look at its upper south branch. We waded through
snow more than knee-deep over the sharp mountain-side beyond
the camp, till the glacier was reached on the west side of Riffel
promontory. Here we plunged in among the séracs, made our
way directly through them, and ascended the glacier on its
south side, a more direct route than that followed the previous
year. At first it was invigorating work climbing over well-
bridged crevasses and up the sides of hard-coated séracs, and,
as long as the surface remained frozen, the coolies followed with
composure if not satisfaction. But when the smoother snow-
covered upper trend was reached, the sun, so powerful at these
heights by nine o'clock, caused the outer crust to soften, and
sinking in was then the order of the day.

We and the guides put on snow-shoes, which helped us
greatly, and we sped forward briskly for some time, until we
realised that the coolies were falling behind. We halted to wait
for them, and at last they came up, sinking in above the ankle
at every step. When opposite the place where Sérac Camp
had stood we looked in vain for its site. The whole slant was
snow-bound. On our return, crossing over the glacier we
marched down the slant to where it had been, but found neither
tent-terraces nor stone-cairn. If these still existed, they lay
deep under the débris of snow and ice-avalanches, that had
swept the whole slope and doubtless destroyed every vestige of
our handiwork. By noon the snow was knee-deep. We
continued on till 2 p.m., not urging the coolies very much, as we knew it was hard work for them. We had then reached a flat place on the main glacier opposite the entrance of the branch we were heading for, so we camped here at an altitude of

15,766 feet (Border Camp), having covered the inspiring distance of five miles.

Here the Chogo Lungma widens out into a large basin formed by the entrance from the south-west of its highest southern branch, a glacier as large as the Haramosh, which breaks into the Chogo Lungma in a great, much-fissured ice-fall, full of large crevasses and abysses. The walls of these afford beautiful

\[ M. \]
examples of névé-stratification, presenting layer above layer of ice, each sharply defined from its neighbours, the product of the snows of successive seasons.

The next morning at daybreak the guides and ourselves made a reconnaissance upon the snow-wall to the north of the camp, to see whether it might be used as an approach to the high peaks above, which we afterwards ascended, but we found it so covered with avalanche-débris, overlaid by deep soft snow, that, after climbing 1,300 feet, we saw it would prove impossible for coolies. Returning to camp we started at nine o'clock to force our way as far as possible up the branch-glacier. On this day the snow conditions were worse than before. The higher we went the deeper became the snow. We followed up the middle of the ice-fall, above which the glacier was seamed in
ASCENDING ICE-FALL ON CHOGO LUNGMA.
BROUGHT TO A HALT AT TOP OF ICE-FALL.
ASCENDING CREVASSE GLACIER.

all directions with small crevasses under the snow, into which someone was constantly stepping. The caravan struggled on for four hours, covering two and a half miles, when at 1 p.m., the coolies being spent, we camped in two feet six inches of soft snow.

During this season so much snow had accumulated above 17,000 feet, that loaded coolies could not march on it with advantage on clear days after nine to ten o'clock. During the night it froze so that it would bear the weight of a man, but soon after the sun struck it, it became soft. As it was dangerous to start out before daylight, now after six o'clock, on account of crevasses, the time when marching could be profitably done was short.

At 6.30 a.m. we started with guides and porter, all the party on snow-shoes, to examine the glacier above. We pushed on for three hours, sinking in somewhat in spite of snow-shoes, till we came to an ascending plateau with large transverse crevasses, one immense one extending entirely across the width of the glacier. Above this the glacier was strewn with blocks of ice, the débris of avalanches, which, falling from the steep walls on either side, sweep its whole width, making its ascent a risky undertaking. It stretches away two and a half miles further with a steady rise to a beautiful snow-col, which we estimated to be at least 19,000 feet high, whence it undoubtedly descends to join the Haramosh glacier, as the latter falls towards the Indus. We did not attempt to go beyond the great crevasse, which would have involved crossing the glacier and ascending the dangerous slopes above its ends. The snow here was so deep that our axes could be thrust into it up to the blades, without encountering any resistance. By trampling down a standing-place we were able to get a hypsometric reading, which gave the altitude attained as 18,008 feet.

We now retraced our steps and reached camp about noon. The sun on this day burned with great vigour. We felt it
very much by eleven o'clock, and at twelve it seemed as if one
could not endure the heat, that through a thin veiling of cloud
poured down from above and was reflected with as great
intensity from the white surface around and beneath. At one
p.m. the sun-thermometer registered 204° F., the shade being
56°. From this circumstance the camp was named Highest
Temperature Camp. Its altitude was 17,322 feet.

As we approached the camp, the tents presented a peculiar,
wilted appearance, resulting from the loosening of the pegs
by the heat, thus permitting the cords to relax and the tent-
walls to collapse. In such a case there is no use in attempting
to span the tents anew until after sunset, when the snow
freezes again. Before that not a peg will hold. If one
indulges in the luxury of sitting on a camp chair, either in
the shade of the relaxed canvas or outside, for the purpose of
taking an observation, the chair-legs are certain to slump
suddenly, perhaps to the detriment of the instruments in hand.
The only seat that has any stability, until the snow freezes, is a
box or a mackintosh.

It might be supposed that at altitudes of 16,000 to 20,000 feet,
in a region covered with ice and snow, where the shade tem-
perature rarely exceeds 55° F. at noon, and at night always falls
as low as 20° F., and sometimes to the neighbourhood of zero,
one would not suffer from heat. The reverse is, however, the
case. On clear and partially cloudy days, as soon as the sun
appears above the mountains, the heat of its rays becomes
quite sensible, and after nine o'clock one feels as if one were
in a fiery furnace. The more snow there is—at these altitudes
everything except perpendicular rock-faces is usually covered
with snow—and the fresher and whiter it is, the greater the
heat. The reflected heat is as hard, if not harder, to bear
than the direct heat of the sun, and shielding oneself from the
direct rays of the latter affords no relief, so long as one is
exposed to the reflection from the snow. With new snow the
EFFECTS OF HEAT.  269

heat by noon becomes intolerable, and together with the altitude may cause headache and lassitude.

The effects of the reflected heat on the skin of Europeans are more severe than we have ever seen at sea-level or at low altitudes. The hands and face are soon burned to a deep copper red. The skin of the face becomes swelled, vesicated, and even blistered. The lips likewise swell, and become covered with exceedingly painful herpetic eruptions, which require a month to heal. In fact, one becomes so disfigured as to be almost unrecognisable. The submaxillary glands enlarge and become tender in sympathy with the facial inflammation. The pain, especially from the lesions of the lips, is referred to the dental nerves, and the explorer often comes to doubt the integrity of teeth, with which he has never before had occasion to quarrel. We tried to protect our faces by wearing white linen masks, but in spite of apertures for nose and mouth, we found they interfered with respiration to such a degree that they were cast aside as useless. Moreover, they were uncomfortable, the reflected heat burning strongly through them. In any case, to be really effective, the white linen should have a lining of black or red, which combination has been found in the tropics to afford the best protection against the sun's heat.

As a comparison with the effect of heat on the skin in the Indian plain, we may state that, in the course of our extensive cycle-journey of 14,000 miles in India, we were exposed day after day for weeks together from morning till night to the full blaze of the Indian sun, in shade temperatures reaching above 100° F., with no protection to our faces except sola topis, and our faces were never burned so as to be in any degree painful.

The lighter the complexion the more one suffers from the heat, both direct and reflected. The darker-skinned coolies and servants with us were not affected at all, while some with
blue eyes, brown hair, and moderately dark skin showed slight reddening of nose and cheeks, but nothing more. The Europeans of the party shed the cuticle of their faces every three or four days. This suggests a reason why the application of burnt cork to the face may prove to be an efficient protection, as has been asserted to be the case. We tried this after our faces had been painfully burned, and thought the skin felt cooler for it; but we did not persevere sufficiently long in its use to be able to express a decided opinion as to its merits.

The actual temperature of the sun's rays may be judged from the following figures, some of which have already been given. The maximum temperatures taken with the black bulb solar thermometer on the only ten available clear days between 18th July and 17th August, 1903, were:

<table>
<thead>
<tr>
<th>Date</th>
<th>Altitude</th>
<th>Time</th>
<th>Sun Temperature</th>
<th>Shade Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>18th July</td>
<td>14,067 ft.</td>
<td>1 p.m.</td>
<td>183° Fahr.</td>
<td>66° Fahr.</td>
</tr>
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The maximum temperature on these days, as on others when the weather was such that comparative temperatures could be taken, occurred between noon and one p.m., generally, though not always, nearer the latter time, as was also true of the high maxima in the Shigar valley. High temperatures approaching the above were also observed on different occasions at eleven a.m. and two p.m., when clouds or other causes prevented observations at twelve and one; but as
RIFFELHORN, NORTH SIDE, ASCENDED IN AUGUST, 1903, BY MRS. BULLOCK WORKMAN AND GUIDES.
COMPARATIVE SUN AND SHADE TEMPERATURE. 273

temperatures at these times do not represent the real maxima, we do not quote them.¹

Compare these with the highest sun and shade temperatures recorded during the summer of 1903 at two stations not much above sea-level in the plains. The figures were kindly furnished by Sir John Eliot, M.A., F.R.S., K.C.S.I., Meteorological Reporter to the Government of India and Director-General of Indian Observatories. At Alipore, near Calcutta, the highest sun temperature was 161.9° F. on 22nd May, the shade temperature being 106.2° F. At Lahore the highest sun temperature was 172.6° F. on 31st May, the shade being 113° F. The highest recorded sun temperature of the whole summer at these two representative stations in the plains was 10.4° F. lower than the lowest maximum above 14,000 feet, and 31.4° F. lower than the highest.

The above figures show that at high altitudes, where the air is much rarefied and freer from moisture, the sun burns with greater power than near sea-level, where a considerable part of its heat is absorbed by the denser and more vapour-laden air before reaching the earth's surface; but in the former case the heat brought by its rays is quickly dissipated by rapid radiation and cooled by contact with the great quantity of snow and ice, so that the shade-temperature remains low, while near sea-level, in the absence of these cooling agencies, it is raised to a high point. The temperature of the sun's direct rays at high altitudes may be almost unendurable, and yet ice and snow may remain hard frozen in deep shadow near by. Almost immediately the sun leaves a snow-surface freezing begins, the cold contained in the ice asserting its power.

It will be noticed that the highest shade-maxima do not always coincide with the highest sun-maxima, any more than

¹ Temperatures considerably in excess of any of those above quoted were met with on a later expedition, the consideration of which will be reserved for the full report of that expedition.
they do at lower altitudes, varying undoubtedly under similar meteorological conditions. The temperature of 204° F. registered at 17,322 feet was not abnormally high, being exceeded by the temperature of 206° F. recorded in June in the Shigar valley, and being equalled by a record at the same altitude in 1902. Could observations have been taken at high altitudes during the heated term in June, when the sun temperature reached 203.8° and 206° F. in the Shigar valley, at an altitude of 8,000 feet, in all probability still higher readings would have been obtained. The thermometer used was compared and found to correspond with the most reliable one at the Government station at Lahore.

The obvious deduction from these figures, and also from the physiological effects stated above, is, that the higher the altitude and the thinner the air, the greater the energy with which the sun's rays strike the earth. Also the sudden change from great heat by day to severe cold at night is undoubtedly an important factor in the rapid disintegration, which is taking place in the exposed rocks of these high Asiatic mountains. Nearly all the surface rocks of the mountains we have climbed in Baltistan have been found rotten and crumbling, the constituents of the sandstones and quartzites in particular having often so lost their cohesion that they could be rubbed to sand between the fingers.

We discussed the advisability of reascending the glacier. Aside from the danger involved it would be necessary, in order to reach the col, which alone would make the attempt worth the while, to move the camp up through the deep snow at least to the large crevasse, a difficult undertaking with coolies without snow-shoes. We should also have to send down for more food for them, which would involve a delay of two days, which we could ill afford, as a good deal of more important work yet remained to be done, and the season was far advanced. It was therefore decided to return to Riffel Camp.
ASCENDING SOUTH ARETE OF RIFFELHORN.
The next ten days were spent in camp, partly waiting for the weather to become more settled, but chiefly on account of the non-arrival of ata, without which no radical move could be made. We had ordered and paid for forty-two maunds a month before this, with directions to have it forwarded immediately, but up to 8th August only nineteen had arrived. While waiting for the remainder, by way of utilising weather not sufficiently certain for high climbing, Mrs. Bullock Workman and the guides made a traverse of the Riffelhorn. They skirted the east flank of the mountain overhanging Haramosh glacier, until a long arete at its rear was reached. The ascent of this required an hour of stiff climbing over rotten shale-rocks, so loose in many places that they had to be dislodged and hurled down to the glacier before footholds could be obtained. Next followed a long precarious traverse along a narrow ledge, below which fell a sheer precipice of five hundred feet. Before leaving this, several short but deep snow-patches had to be crossed, which being still in shadow were fairly secure.

Another sharp arete broken by two rather shaky gendarmes brought them to a snow-covered notch, which separates the narrow pointed apex from the main mountain. After a short rest this was crossed and the final needle attacked, which offered only scant footholds but furnished plenty of work for the hands. After twenty minutes of this the stone-man on the summit was reached, from exactly the opposite direction from that in which the usual ascent had been made. This traverse and ascent takes two and three-quarters hours at a moderate pace, which, owing to the gradient and the uncertain material of the mountain, cannot well be varied. After adding a note of the traverse to the record in the cairn, the descent to camp by the usual route was made.
CHAPTER XI.


The ascent of a snow-peak of over 20,000 feet in the Chogo Lungma region is a matter of greater difficulty than of one of a similar height in Ladakh, Tibet, in some other parts of Himalaya, or the Andes. Here transport has to be taken first several marches over a long complex glacier, such as does not exist in these other regions, and can only be compared in size with those of Alaska. Again the snow-line here is comparatively low, while in Ladakh and some other Himalayan districts it is as high as 18,000 or 19,000 feet, and in the Andes still higher. Just where it will be found at any given time is, as has already been stated, uncertain.

The highest camping place we were able to find, that was not on snow, was at 15,200 feet, though some slopes were bare to a considerably higher altitude. After a good deal of observation we placed the snow-line as low as 16,000 feet. The practical point to be considered is, that above 11,000 feet all marches are on ice or snow, and that to reach even moderately high altitudes snow-camps must be made. With each successive snow-camp the courage of the transport-coolies diminishes. Another serious obstacle is the weather, which, during July and August, the only high-climbing months, is affected by the south-west monsoon. During some seasons there are only one or two fine days at a time, when of course high climbs are out of the question. During others, when the monsoon is lighter or ceases earlier, five or more
PYRAMID PEAK, 24,500 FEET, ASCENDED TO BLACK POINT ON SKY-LINE,
23,394 FEET, AUGUST 12, 1903. TAKEN FROM RIFFEL CAMP, ELEVEN
MILES DISTANT. (TELEPHOTO.)
successive clear days occur, which opportunity should be seized at once. Thus the climber in the Chogo Lungma district is handicapped by ice, the low snow-line, coolies, and weather.

Soon after our arrival at Riffel Camp three splendid snow-peaks, soaring up from the ice-clad mountain-wall separating the Chogo Lungma from Basin glacier, attracted our attention, and we determined, if a favourable opportunity should offer, to attempt the conquest of at least one of them. The highest, which pierces the sky at an elevation of 24,500 feet or over, is the dominant peak of the region and is seen from nearly every part of the Chogo Lungma and its upper tributaries. During the first summer the weather was so continuously bad that no attempt on the peaks themselves could be made with any hope of success, though reconnaissances from the Chogo Lungma and Basin glaciers, from the Bhayakara Col, and Cornice Peak gave us a fairly good idea of where they could and could not be attacked.

The first and lowest peak is, technically, the most difficult and dangerous of the three. From its corniced summit it slopes steeply down, broken into a succession of ice-falls with yawning abysses, to a great rock-precipice two or three thousand feet high overhanging Basin glacier. On the south side it sweeps down in long snow slants, somewhat less sharp though similarly broken and much exposed to avalanches, to the Chogo Lungma. In fine weather an ascent might possibly be made from the Chogo Lungma, though, as our reconnaissances on that side had shown, the slopes were not in a condition favourable to the attempt, and, in case of a storm, retreat in that quarter would not be possible. In Himalaya a good line of retreat should ever be kept in view. The best, but by no means easy, line of ascent runs from the top of the wall up the south-east side of the cone. To reach the top of the wall is in itself a mountaineering feat of no mean order.

On 7th August, as the weather promised improvement, the
guides were sent up Basin glacier to inspect the approaches to the wall on that side. On their return they reported the slope steep and its ice much broken, but they thought a caravan could surmount it, also that there were pools of clear water on the glacier at its base not far from where the upward route would have to be made, and some rocks where the coolies could light their fires. Here the first camp could be pitched.

Everything was made ready. Saying nothing of mountain intentions we selected twenty of the best coolies to carry our kit, consisting of one eight by eight mountain-tent, four flannel-lined Mummy tents, a week's food-supply for us and guides, two primus stoves, petroleum, and two coolie-tents. The coolies were ordered to cook three days' rations for themselves, and two extra coolies were chosen to carry these rations to the first camp. The khansamah was instructed to send four more coolies with additional supplies under charge of one of our Gurkhas, to follow our track on the second morning after our departure.

On 9th August, with guides, porter, the twenty-two coolies, and one tent servant, at 5.30 when it became light enough to pick our way through the serac-belt surrounding Riffel promontory, we started for Basin glacier. The mountain-ascent really began at Riffel Camp, since after leaving it we were always on ice and snow, and the path was always upward. We crossed the Chogo Lungma to the base of the great ice-fall, three-quarters of a mile long, with which Basin glacier joins the Chogo Lungma. As the ice-fall was impassable, steep beds of nevé bordering it were ascended to the glacier above. This glacier leads directly up under the precipitous walls of the peak which was our first objective. Above the ice-fall its flow was fairly smooth and afforded a good path, except for a covering of soft snow which grew deeper as we ascended. We Europeans here put on snow-shoes. If coolies had sufficient understanding to learn their use, it might be well to supply a caravan with them, though it would be a costly undertaking. We found them
of great assistance in traversing the higher parts of the glaciers, where there was much soft snow.

At 1 p.m. camp was pitched near the head of the glacier in eighteen inches of soft snow under the steep flank of the first peak. This was called Pool Camp. Its altitude was 16,352 feet. The coolie-tents were placed below ours near a fine pool or lakelet of glacial water. We passed several similar pools on the way up. They were not seen on this glacier the preceding summer, but this season they had formed at intervals to a point
somewhat above Pool Camp. Snow covered their edges and dipped down into the water. Anyone who has been obliged to melt snow to obtain water for camp purposes will appreciate the convenience these pools were to us.

At 5.30 a.m. on the roth we started directly up the steep flank of the wall, which is here continuous with that of the first peak, and falls in an uninterrupted series of broken ice-slopes from summit to base. The route, as we made it, traversed some of these and zigzagged up others, with frequent detours to snow-bridges over the appalling crevasses which blocked our way in all directions. For the first two and a half hours, the snow being hard, good progress was made, though the coolies wished to rest all too often. We urged them constantly, telling them it was necessary to cover as much ground as possible before the snow softened, when work for all would become more difficult. This information did not appear to stimulate their climbing ardour; in fact, a coolie's ardour is rarely stimulated by anything except a bakhshish and a return march.

By eight o'clock a snow-ledge was reached, overhung by an ice-wall broken by a huge schrund fringed with massive icicles ranging from fifteen to twenty-five feet in length. Here we stopped for breakfast. We were now well above the glacier, and the view was opening up. It was particularly fine of the Bhayakara La just opposite. We could see very distinctly the nature of the risks incurred in climbing it, and were glad our path did not lie again up its dangerous slopes. The heat of the sun, which already burned with fervour, had by this time softened the snow appreciably, and we had been sinking in above the ankles about every third step. In half-an-hour the coolies came grumbling up, for they were plunging in even deeper.

Savoye here left the rope and devoted himself to the task of encouraging and helping the coolies, while the rest of us led the way up a steep arête, which was ascended straight, Petigax and
SCHRUND AT ABOUT 18,000 FEET WITH ICICLES.
the porter treading out steps in the softened snow, which soon became knee-deep. After the recent storms it was at its worst on the sharp inclines, and much increased the danger from crevasses, which it concealed without being compact enough to form available bridges over them. Here for some time we had the advantage over the coolies in that they had to advance steadily, there being no plateau where they could throw themselves down and force a camp.

The long, wearisome arête merged at last into gentler inclines, which led to a nearly level snow expanse, where, as a good climb was already a fait accompli, we sat down in the blazing sun to wait for the caravan, which made but slow progress. In about an hour its head came crawling up, impressed onward by Savoye's cheery voice calling out constantly "Atcha rasta." After a while the last loiterers arrived, all, as they came up, throwing themselves down in various attitudes of distress, some nursing their feet, others holding their heads. We had wished to push on up another high ridge before camping, but, taking into consideration the fact that the coolies had had a fatiguing climb of seven and a half hours, we decided not to urge them further on that day, the more so as clouds were coming up and the wind rising.

The soft snow was trodden down to make a camping place, and tents were pitched at an altitude of 18,811 feet, the camp being named Intermediate Camp. Here, at 1 p.m., the black-bulb thermometer indicated 192° F. in the sun, the shade temperature being 55°. The site was magnificent, commanding, in addition to a view of the great peaks immediately around, a coup d'œil of more than twenty miles down the majestic sweep of the Chogo Lungma, banded with the snaky curves of its giant medial moraines, above which soared a vista of peaks stretching in tortuous ranges into the dim distance. Shortly after camp was established the sky darkened, and wild snow-flurries shook the small tents, as if bent on tearing them from
their insecure moorings. The barometers remained high, however, and the sky soon cleared. Having melted snow and cooked dinner over primus stoves, we turned early into our sleeping-bags.

The third day at snowy heights broke clear and cold. The tall, silvery peak in front and far above called loudly to us in the silent, grey-blue dawn. We were up at three o'clock, as we intended to start the caravan for higher regions at five. At four the servant was sent to call the coolies, whose tents stood behind a snow-hillock some five hundred feet distant. After a time he brought word that they refused to get up. Our tents being now struck, and all our effects packed ready to march, we did not fancy standing shivering on the snow in a temperature of 16° F., at an altitude of nearly 19,000 feet, awaiting the caprice of the coolies. We further knew that this open disobedience of orders, if tolerated even for a short time, would put an end to discipline and result in a failure to get any of the peaks.

Accordingly Dr. Workman and Savoye went down at once to the coolie-camp, and found the coolies snugly ensconced in their tents, not one having stirred. Without any ceremony the tent-pins were pulled up, and, as the coolies crawled out from under the prostrate canvas, they were commanded to put on their boots and get ready to march. This determined attitude had the desired effect. By six o'clock, an hour late, they were loaded and in motion.

Our plan on this day was to pass the first peak by, and, traversing its flank, camp on a higher plateau at about 21,000 feet, which would give access to both peaks. A long ridge seamed with crevasses was first in order, which it took more than an hour to negotiate. Getting the leading coolie over a crevasse is often serious work, but once the leader has passed the others manage to flounder over. The slopes now became steeper. Fearing lest the courage of the coolies should
VIEW OF TWENTY MILES DOWN CHOGO LUNGMA FROM INTERMEDIATE CAMP, 18,811 FEET. SNOW PEAK ON RIGHT IS CORNICE PEAK.
MOUNTAIN-SICK COOLIES.

fail owing to the knee-deep snow, Dr. Workman and Savoye remained with them to help and encourage them, while the others tracked out a path some distance in front. Whilst assisting a coolie over a crevasse, Dr. Workman's topi was struck from his head by the coolie's stick, and away it bounded down the steep slant with lightning speed several thousand feet to the glacier below, where it probably now reposes. Possibly several hundred years hence it may be yielded up by the ice at the end of the tongue, and furnish material for surmise, as to what kind of a tragedy has happened in the snows above.

Mrs. Bullock Workman had her topi blown off by the wind on the ascent of Koser Gunje in 1899, and it also, after falling hundreds of feet, was lost in a crevasse. The snow, into which our feet sank eighteen inches or more, was powdery, having been chilled by the low temperature of the night. Our feet tingled from its cold, and we had to stamp them constantly to prevent their freezing.

By nine o'clock the advance party, having distanced the leaden-footed coolies by a height of at least five hundred feet, and having reached a point over 20,000 feet in altitude, from which they could overlook the Chogo La leading westward from the head of the Chogo Lungma, were cutting steps up the frozen surface of a steep wall just below the upper plateau we were aiming for, when an imperative call from those behind arrested their progress. On asking what the trouble was, the answer rang clear through the limpid air, that some of the coolies were mountain-sick and the others refused to advance. With alarm they looked down and saw several coolies lying prone on the snow. "Offer them bakhshish and tell them the road is good, and it is only half an hour to camp." And they waited, trembling for their peaks, so within grasp and yet so hard to win because of unwilling coolies.

Those below offered and argued, but to no purpose. The coolies, who were or pretended to be ill, lay as if dead, and the
remainder continued obdurate. There being no hope, the advance party descended from the well-earned wall and rejoined the caravan. Only eight coolies were ill. The others seemed lively enough. We now proposed to curtail the luggage and go on with fourteen coolies, leaving a tent for the others. A large bakhshish was offered them, but not one of them would go further. "Not for five rupees each," said the spokesman, to be found in every coolie band; "we would rather cut our throats," accompanying the remark by a graphic gesture of the hand across his throat. This was a common remark when the coolies did not like the appearance of a snow-slope. The observation has been made more than once by those whose knowledge of coolie-humanity is confined to the exigencies of ordinary travel, that coolies will do anything if well paid. It is doubtless true, in general, that coolies, like civilised men, can be bought at a price, but there are times, and this was one of them, when the Balti coolie cannot be induced by any reward which may reasonably be offered him to do that which fear or some other controlling motive may make him unwilling to do.

The question of camping on a small level projection near where we stood was next mooted, but a glance around showed it not to be safe from avalanches, so we decided to retrace our steps to a small snow-shelf somewhat lower down at the base of the cone of the first peak, and camp there. This was done, and our highest camp on this expedition was established at 19,358 feet. Here the demoralised coolies settled themselves quite contentedly, and said they must rest a few days before going down. The idea of making a Luftkur-station on a giant snow-peak where a storm might gather in an hour, would certainly not have suggested itself to other than a coolie mind. At 3 p.m. the sun temperature was 180° F., and shade temperature 38° F.

It was now evident, that we had got the coolies to the highest possible point, that no further assistance could be
expected of them, and that we must make the remainder of
the ascent of the higher peaks over the only available route
from here, up the steep broken slants of the first peak to its
summit, which route we had sought to avoid by camping
higher.

The afternoon was spent in preparations for the next day's
supreme effort, which we were determined to turn to as good
account as possible, while Savoye and Petigax fils trod out
steps in the then softened snow for several hundred feet up the
cone. We went to bed early, but did not sleep well. As soon
as we began to doze, and the respiratory movements diminished
in force and frequency, the tissues did not get sufficient oxygen,
and we would start up gasping for breath. All the party were
affected in the same manner. This did not tend to fortify us
any too well for the coming struggle, tired, as we were, by three
days of hard snow-climbing, helping the coolies, and anxiety
cased by their actions, with little sleep.

We would here call attention to the fact that, when any
cause is acting that tends to interfere with respiration, a person
can breathe better in the erect position than when lying down.
At this height, where we suffered when lying, we breathed
perfectly well when sitting or standing, which was also practi-
cally the case at the highest altitude reached. The fact that
the whole party was kept awake by want of breath when trying
to sleep at 19,358 feet, points to the possibility that, in case of
an attempt on one of the highest summits, if camps could be
established at heights of 23,000 to 27,000 feet, and above, as
they would have to be, sleep might be entirely prevented or
interfered with by deficient oxygenation of the blood to such
an extent that a party would be incapacitated from this cause
alone from going any higher.

At two o'clock on the morning of the 12th we were astir,

1 Later experience with seven Europeans, nine in all, at camps 2,000 feet
higher than the above, lends weight to this idea.
and at three, with guides, porter, and two instrument-coolies, left camp by moonlight, with a temperature of 15° F. Roping, we attacked at once the steep pyramid before us, zigzagging up the hard-frozen slope, or traversing, as the nature of the inclines demanded. Owing to the steps trodden the preceding afternoon, good progress was made for some time, though the gradient was steep and broken by no mitigating plateau. At one place we had to make a long traverse of a slant of nearly 70 degrees, below which an appalling precipice of 2,000 feet fell away, suggesting, should one make a mis-step, mysterious death-traps in the silvery night.

Near the middle of this traverse two crevasses running at right angles to our course had to be crossed, which we were just able to jump. But little was said as we pressed steadily upward in the sugary snow. A constant, gentle, cold breeze blew down from the heights above with chilling effect. Our feet suffered most severely, and we were anxious lest they should be frost-bitten. One’s hands are easily kept warm by wearing fleece-lined rubber mittens, but keeping the feet warm is another matter. Nailed boots must of course be worn, but they are always cold. We have tried fur-lined boots, and plain leather ones large enough to admit of wearing three pairs of stockings, the outer pair being of Norwegian goat-hair, but with only negative results.

It would be a boon to mountaineers if someone would invent a certain means of keeping the feet warm at 20,000 feet. Some of us were scarcely conscious of having any feet by the time we reached that height, but by beating them vigorously with our axes until they tingled sufficiently to denote safety, we were spared the extreme exertion required in the rarefied air of taking off boots and rubbing our feet with snow. Just before sunrise the cold seemed hardest to bear.

As we went higher in the waning moonlight, great peaks rose on every side, sharp in outline but ghastly in tone, as if belonging
to a strange, weird world of giants newly fashioned by the hand of Nature, but as yet untouched by the breath of life. Then broke the mauve-tinted dawn, a sudden sheaf of light behind the peaks deepening to a rosy flare at the zenith. The mountains lost their ghastly, inert appearance, as the heavens, their summits, and the whole snowy world below, became bathed with the warmth of colour that heralded the arrival of the sun. At last King Sol came, flinging his rays aslant one great summit,
then another, and finally showing his face over a snowy cone, flooding the endless sea of peaks with gold.

This was sunrise at 21,000 feet. To us, who had watched the night out on the heights, it typified the awakening of the mountains to life by the messenger of a glorious day. For those who study and love the eternal snows know well what a companionable humanity they possess, what varied human moods, whether coquetting with clouds and shadow in mysterious half-tones, or standing unveiled in the searching light of cloudless noonday.

Feeling the lassitude unavoidable at such a height, we climbed the last zigzag of the glittering cone, and at 7.15 stood on the summit, 21,500 feet above sea-level. The top was
SUMMIT MT. CHOOGU, 21,500 FEET, AS SEEN FROM ALTITUDE OF 22,300 FEET ON MT. LUNGYA. TRACK OF ASCENT IN FOREGROUND. MOUNTAIN WALL IN BACKGROUND ABOUT 20,000 FEET. PEAK AT RIGHT, 21,930 FEET.
WE ASCEND A SECOND PEAK.

a rounded snow-cornice, which overhung a sheer precipice of several thousand feet, falling on the north-east to Basin glacier. The temperature was 16° F. and there was but little wind. To the south-east an uninterrupted view of the Mustagh kings greeted us. Masherbrum, Gusherbrum, the Mustagh Tower, our old friends the Biafo giants, and hundreds of others stood out clear, as if only a few miles distant, and above these the huge, dark, abrupt pyramid of K2 hung above a bank of vapour seemingly in mid-air, mighty in its rôle of second to Everest, a warning to would-be climbers. To the south, just across the Chogo Lungma, rose the snow-white needle of Indus Nagar Watershed Peak No. 4, and beyond, above the head of the Haramosh glacier, the towering massif of Haramosh.

The second peak lay beyond, to the north-west, rising, apparently about a thousand feet higher, from a snow-plateau, and separated from us by a long incline. The day was still young, and we were still fit, though gasping somewhat for oxygen on movement. Why not have that peak too? Stopping only half an hour to take food, expose some plates, and read instruments, and leaving one of the coolies, who here gave out, we set out for it, descending a narrow snow-arête and crossing a second one to get upon its flank. The gradients of this were not so sharp as those of the first peak, and its ascent was only a question of avoiding crevasses and endurance of the effects of altitude, and of the fatigue incident to moving upward in snow about ankle-deep.

By ten o'clock we were within twenty minutes' climb of the top, at the beginning of a slope, which at first descended and then rose to the base of the third great pyramid-peak, 24,500 feet, that towers from the same plateau still further to the north-west, and in which the mountain-wall culminates. Here a council was held, at which it was decided that Dr. Workman with the two guides should keep on to a higher point on the south-west arête of the pyramid peak, which commanded a view farther to

m. x
the west, while Mrs. Bullock Workman, not caring to go upon this peak unless its top could be reached, which was on this day manifestly an impossibility, should complete, with the porter, the ascent of the second peak, and there wait till the others should join her. She gained the summit at 10.30. This, like the first one, was found to be a cornice curling over towards Basin glacier. Its height, based on observations then taken and later computed, is 22,568 feet. By this ascent she broke her previous altitude record for women of 21,000 feet a
PYRAMID PEAK, 24,500 FEET, FROM NEAR SUMMIT OF MT. LUNGA. SLOPES MUCH FLATTENED BY ELEVATION OF CAMERA.
second time on this day, and this time by 1,568 feet. On arrival the shade temperature was still 16° F.¹

The view was similar to that from the lower peak, but grander. The crest of the latter was seen far below. It was a day in a thousand. Not a cloud crossed the blue firmament, and the air was still. The noon meal was a simple affair. A bit of meat, kola biscuits, and milk chocolate, soon satisfied the appetite, for hearty meals play but a small rôle in one's itinerary at over 22,000 feet. The lack of oxygen in the air was distinctly noticeable on making the least movement, and even when sitting still there was an indefinite sense of uneasiness and a desire to change position frequently.

As one sat enthralled by the wonderful prospect, the hours passed unnoticed. Often a sudden squall or icy wind mars one's enjoyment at the summit of a mountain, but here there seemed to be an ecstatic pause in life, when the exigencies, even the thoughts and desires of daily existence, fell out of account, as one sat encircled by mountain majesty in the heart of the illimitable silent land of Asia. The other party were watched, as they crept slowly upward and settled like dots on the arête they aimed for.

Man plays a far too important part among the mountains of Europe, too often by his presence turning the grandeur around him into deadly commonplace; but in the glorious unexplored expanse of Himalaya, his rôle is small, permitted as he is now and then for a brief moment to penetrate and gaze upon Nature clothed in her most regal forms. Always beautiful and satisfying even in her lower planes, she here attains her supreme development, and in cadences of wind, light, sun, and snow, sings through the ages her "chant of eternal beauty."

The pyramid-peak, as seen from where our party separated,

¹ She has since climbed to an altitude of 23,300 feet in the Nun Kun range, which places her with the small band of men who have reached a height of over 23,000 feet.
was entirely snow-bound, its apex being formed by a pointed, sharply-defined cornice, which soared into the deep-blue sky like the curling crest of a mighty wave about to break. Directly beneath the cornice is a tremendous precipice, while on its east side the mountain falls in another precipice some 7,000 feet to Basin glacier below. This is a type of many high Karakoram peaks which end in similar cornices pointing towards the north, and usually overhanging abrupt precipices. But little effort of the imagination is required to make these crested cornices seem actually in motion, and they do from time to time break away and give rise to avalanches of incredible size and power. The direction in which they point is due to the prevalence of south and south-west winds.

The rising snow-plateau was ascended to the base of the final
SUMMIT MT. LUNGMA, 22,568 FEET, AS SEEN FROM ALTITUDE OF 23,394 FEET ON PYRAMID PEAK. WALL IN BACKGROUND ABOUT 20,000 FEET. WHITE PEAK TOWARDS RIGHT, 21,930 FEET.
pyramid, one angle of which is formed by a long snow-arête, as steep as the slopes of the first peak, which runs in an unbroken line to the top. All unnecessary luggage being left here, this arête was attacked, and, after some stiff work, the spot selected was reached at 12.30 p.m. Calculations based on the readings here taken, compared with simultaneous reading at our lower station, give the altitude of the point attained as 23,394 feet (the average of calculations by three tables).

The idea of attempting to reach the summit, some 1,100 feet higher, was not for a moment entertained. This, under the circumstances, would have been a foolhardy undertaking. We had already been nearly ten hours in active motion, and had accomplished a fatiguing and, for such an altitude, unusual climb of more than 4,000 feet. Probably in the course of the afternoon the top might have been reached, but the peak would have become the mausoleum of the party, for camp could not have been regained that night, and a night in the open at that altitude would have meant certain death from cold, to say nothing of the danger from fatigue. Could camp have been made at 21,000 to 22,000 feet, the whole party would, in all probability, have gained the summit at 24,500 feet, as the day was windless and perfect, the finest of the whole season thus far. Had the weather been uncertain, or had a wind of ten to fifteen miles an hour blown against us, we should not have reached the second summit. We had seized and utilised, as far as possible, the only opportunity in two seasons.

The view, while similar to that from the two lower summits, had grown with the altitude, and from here was indescribably grand. Over a space of three-quarters of a circle countless thousands of spires of every size and shape shot up in the air as far as the eye could reach, and the high snow-basins and winding valleys between them, some of them at over 20,000 feet altitude, lay fully exposed to view. One could see from
314 ICE-BOUND HEIGHTS OF THE MUSTAGH.

the immense mass of Nanga Parbat, bounding the horizon sixty miles to the south-west, around to Masherbrum, the Golden Throne, Gusherbrum, and K 2, ninety to a hundred miles to the east. Beneath, stretching away for thirty miles, banded by its remarkable, winding, medial moraines, lay the Chogo Lungma. Just across this, in the foreground, rose the beautiful needle of Indus Nagar Watershed Peak No. 4, 22,810 feet, its apex nearly six hundred feet below us. Six miles north-west of it stood Indus Nagar Watershed Peak No. 2, 24,470 feet, and twelve miles to the south Haramosh, 24,270 feet. The Chogo Col, beneath our feet, at the head of the Chogo Lungma, was seen to be the beginning of a snow-pass 20,000 feet high, named by us the Chogo La, that runs for some distance between snow-peaks and then suddenly drops down to a glacier, that slopes gently away to a rock-valley leading, apparently, towards Hispar. This route to the latter would not be available for travellers, on account of its mountaineering difficulties, and no coolies could be induced to pass the Chogo La.

After remaining half-an-hour, all the time that could be spared, to take readings, photograph, and gaze upon such a view as in long mountain experience none of the party had ever seen before—the one view of a lifetime, to enjoy which for half-an-hour was only an aggravation—the return was reluctantly begun toward the second peak, which was reached at three o'clock.

After a half-hour's rest, we all started to descend to camp, which had to be reached before darkness set in, as the dangerous slopes of the first peak could be safely negotiated only by daylight. The way was fairly smooth and progress rapid till the first peak was regained. Picking up the second coolie on its summit, where he had sat contented the whole day, glad to escape the higher work, we started down its abrupt flank. It was a question which was more nerve-wearing, ascending the
COOLIES GLISSADING ON FLANK MT. CHOGO. SLOPE MUCH STEEPER THAN IT APPEARS.
dizzy frozen incline by night, or descending the same when soft. With each downward step we plunged into the snow above the knees, which, after the hard climbing of the day, was most exhausting. The descent was made without accident, and we reached camp at seven o’clock, as the short twilight was deepening into darkness.

Hotel conveniences or a blazing log-camp-fire would have been welcome after our sixteen hours of work, but no such luxuries exist in the kingdom of the gods, and the tents frozen to the snow were cheerless substitutes. Having our own cooking to do, we shirked it altogether, and, without troubling ourselves about food, sought sleep as soon as possible. The next morning, the fifth at high altitude, with barometers falling and clouds rolling across the sky, we gave orders for a speedy downward move. On two favourable slopes the opportunity to hasten our pace by glissading was taken advantage of by the whole company, including the coolies, who seemed to enjoy immensely this, to them, new form of sport.

It was well we did not linger, for before we were half-way across the Chogo Lungma we were enveloped in a storm, which for three days shrouded the great peaks we had won under a radiant sky, in cloud and snow. When we came to the séracs, which in any case would be difficult to pass in the snow-darkened air, the bridges by which we had crossed five days previously were found destroyed by the movements of the glacier, and a new route had to be sought. These séracs are the worst of any on the glacier to get through, being composed of much-shattered ice-pinnacles, many of them knife-edges falling on both sides to profound crevasses, rendered brittle and flaky by the alternate thawing and freezing to which they are subjected.

The first of the two peaks conquered was named Mt. Chogo, the second Mt. Lungma, the third and highest Pyramid Peak.

The opinion has often been expressed of late years that
mountain-sickness may be largely or wholly avoided by a gradual approach to high altitudes, so as to permit the system to become accustomed to diminished pressure and oxygen. This opinion does not appear to be based on any very conclusive facts, and our experience tends rather to controvert than to substantiate it.

We have climbed in Himalaya with thirteen Europeans, making fifteen in all. Of these, twelve have reached an altitude of 21,000 feet, seven that of 22,568 feet, six that of 23,000 feet, five that of 23,300 feet, and three that of 23,394 feet. Only one was completely prostrated by mountain-sickness at 21,000 feet, so that he had to be sent back to a lower camp. One other, previously immune even to 23,300 feet, was, after being at high altitudes for six weeks, mildly affected by this malady between 19,000 and 20,500 feet, but was able to eat a satisfactory lunch at the latter altitude. The rest escaped any symptoms of it. We have ascended comparatively rapidly, usually reaching heights of 17,000 to 18,000 feet within a month after leaving sea-level. Much of our work above that height has been done within six weeks, and our highest at two and a half months.

In crossing the Skoro La in 1899, we took with us thirty-five coolies, who had lived all their lives at an altitude of about 8,500 feet, and most of whom had crossed the 17,000 feet Skoro La to Askole more than once. The first day they made a light march of only three hours. The second day, at an altitude of 15,500 feet, half of them were so prostrated by mountain-sickness that we were obliged to camp on a steep and exposed mountain-side.

In 1902, while ascending the Chogo Lungma, one of our instrument-coolies, who had always lived at Arandu, 9,500 feet, became very ill at 12,500 feet, and continued so for two days, after which he recovered and went with us to 19,000 feet without any further trouble. The following year, after remaining at our base camp at 14,000 feet for two weeks, he became severely ill again on his first march up the glacier at 15,500 feet.
MT. CHOGO AND MT. LUNGMA FROM BASIN GLACIER. IN FRONT, BROKEN ICE-SLANT TRAVERSED IN ASCENT AND DESCENT. MUCH FLATTENED BY UPWARD INCLINATION OF CAMERA.
MOUNTAIN-SICKNESS.

On the occasion of the ascent described in this chapter, out of twenty-two coolies from villages at altitudes of 9,000 to 9,500 feet, who were in excellent condition, having lived a life of ease for a month at our 14,000 feet base camp, during which time they had all put on flesh from the consumption of double the rations they would have used had they been obliged to furnish their own provisions, eight became so ill at 19,600 feet, that they threw themselves at full length on the snow, where they lay utterly indifferent to all attempts short of actual violence to induce them to move.

Whatever may be found to be the effect of a prolonged sojourn at high altitude as a modifier or preventive of mountain-sickness, it is certain that a large proportion of our coolies on these expeditions, who had a lifelong advantage over us of 8,500 to 9,500 feet, besides that of being on their native ground, suffered severely from this affection, while the nine Europeans engaged in them escaped entirely. These were all Balti coolies. It may be that race may make some difference in predisposition, as Suru coolies with us later, who have an admixture of Mongolian blood, did not suffer to the same extent.

It seems to be the case with mountain-sickness as with seasickness, the symptoms of both of which are practically identical, though the causes differ, (1) that some persons are immune to it at any altitudes that have been reached and under all circumstances, even that of extreme fatigue; (2) that others are affected, at given altitudes on some occasions and not on others, probably according to the amount of fatigue undergone and the condition of their bodily health; (3) that still others always suffer at certain elevations, just as some persons always become sea-sick on moderately rough water. How far the last two classes may be benefited by living for some time at high altitudes will have to be determined by further experience.

When we visited the Chogo Lungma the first time, we knew that two peaks near its head had been fixed both for position.
and altitude by the Indian Survey. The first of these, the Indus Nagar Watershed Peak No. 4, an important landmark, although not charted on the Survey map and although a glacier occupies the place that should be given to it, was easily identified. The second, the Indus Nagar Watershed Peak No. 2, 24,470 feet, is shown on the map, about a mile too far east, but the cartographical topography for miles around it is so hopelessly at variance with the actual topography that unfolded itself to our eyes, that among several almost equally high peaks, we could not be certain of its identity.

Before returning a second time to the Chogo Lungma we wrote to the Superintendent of Surveys at Dehra Dun for further information, and received the reply, that the Peak No. 2 in question was the highest peak at the head of the Chogo Lungma. This information was, of course, based on observations from a distance of many miles, and not from observations on the spot. We would here acknowledge the courtesy and kindness of Col. St. George C. Gore, R.E., formerly Surveyor-General of India, of Lt. Col. S. Burrard, R.E., Superintendent Trig. Surveys, and of J. Eccles, Esq., M.A., Officiating Superintendent Trig. Surveys, in giving us, on different occasions, information and assistance of importance to the prosecution of our work.

Pyramid Peak answering this description, and being in our opinion, as well as in that of Petigax, Savoye, and Zurbriggen, not only the highest but by far the most imposing mountain at the head of the Chogo Lungma, we concluded it was the one we sought. Here the matter rested and we supposed it settled, and later believed the ascent to 23,394 feet to have been made on the Indus Nagar Peak No. 2. When we came to construct our map, the other fixed points having been placed upon it, the position assigned by the Survey to the Indus Nagar Peak No. 2 fell, not on Pyramid Peak, but on another high but less conspicuous summit four miles south by west of it on the south side of the glacier, and it was impossible to substitute Pyramid
CREVASSE GLACIER SIX MILES LONG, THE UPPER SOUTH BRANCH OF CHOGO LUNGMA. COL AT TOP ABOUT 19,000 FEET. FROM SUMMIT MT. LUNGMA.
PYRAMID PEAK AND PEAK TWO.

Peak for this without dislocating the topography of the whole region.

We were thus placed in the dilemma of considering either that the Survey had miscalculated the position of Peak 2, thus giving it a position four miles too far south, or that Pyramid Peak is another and higher peak not seen and triangulated by the Survey. Three circumstances favour the former view—

(1) Pyramid Peak is manifestly the highest and most prominent peak in the region, and is the one of all others to attract attention from afar. (2) The position of Indus Nagar Peak 2 was fixed by three rays from stations thirty-seven, forty-three, and forty-nine miles respectively, to the south beyond the Astor river. These stations in point of longitude are very near together, the two outside ones being only about four and a half miles apart, so that the rays from them would cut one another on Peak 2 at a very acute angle, and an error of position in the north and south direction might conceivably be made. (3) There is, apparently, nothing between the three stations and Pyramid Peak to prevent the latter being seen from them. These stations are situated in direct line between Pyramid Peak and Nanga Parbat, and from the height of 23,394 feet on Pyramid Peak, Nanga Parbat was plainly seen through the opening in the mountain walls occupied by Crevasse glacier, the highest tributary of the Chogo Lungma, the col at the head of which is only about 19,000 feet. Still, as a peak occupies practically the position assigned to Indus Nagar Watershed Peak No. 2 by the Survey, we do not undertake to assert that the Survey is in error, but chart Pyramid Peak on our map as another and distinct peak.

The height assigned to Pyramid Peak is estimated, no measurements having been made under the circumstances to determine the difference in height between it and Peak 2. Higher it certainly is in the opinion of all who studied it, but, to be within the limit of probability, we have placed it only
thirty feet higher than the altitude assigned to Peak 2, although it appeared to be at least three hundred feet higher. The altitude of Peak 2, having been fixed by only two rays, may possibly have been calculated too high, in which case the small difference estimated may really represent a considerably greater one. From the highest point reached on Pyramid Peak the summit corresponding in position to Peak 2 did not appear so much higher than some untriangulated peaks near it as to attract special attention. If Peak 2 has the altitude assigned it by the Survey, the altitude of Pyramid Peak is placed too low.

This shows the difficulty that the explorer may have in identifying desired features in the little known or unexplored distant regions of Himalaya, where only a few peaks seen from afar are placed upon the map as fixed points, other details being often drawn in from imagination. It is not surprising that numerous mistakes in identification have been made by Himalayan explorers and mountaineers.
INDUS NAGAR WATERSHED PEAK NO. 2, 24,470 FEET, CHOGO LUNGMA.
CHAPTER XII.

Farewell to Choga Lungma—The Bolucho Glacier—Caravan ascends a Virgin Pass—Passage of Dangerous Cornice—Coolies glissade a Thousand-Foot Wall—Propitiating Mountain Gods with Food-Offerings—Goats and Sheep prove Good Mountaineers.

On the 14th, 15th, 16th, and till 9 a.m. of 17th August rain or snow fell with but few intermissions. Avalanches, which

had fallen during the whole season much oftener than in 1902, on account of the great quantity of snow, increased in frequency during these four days, crashing down at short intervals from the heights around, while every now and then some great sérac
would give way and tumble over into the depths below with a thunder which rivalled that of the avalanches.

As our work on the Chogo Lungma was now completed, these days were spent in preparations to finally leaving Riffel Camp for other fields of activity. Our plan was next to ascend and explore the Bolucho glacier, the fourth large north branch of the Chogo Lungma, and seek a passage from it across the mountains to the Kero Lungma glacier, which runs parallel with the middle portion of the Chogo Lungma, and is separated from it by a high mountain range, that sends down glaciers on both sides to the two larger ones. Its walls fall most abruptly towards the Kero Lungma, and its upper ridges, where broken, are gashed by most eerie-looking cols.

We built a stone-cairn on the slope near our tents, in which
VIEW OF LOWEST TWO MILES OF BOLOUCHO GLACIER AND ITS JUNCTION WITH CHOGO LUNGMA FROM RIVULET CAMP.
DEPARTURE FROM RIFFEL CAMP.

A tin box was placed, containing a record of our exploration and ascents made in that region during the two seasons. The cairn is a massive structure seven feet high, likely to defy for a long time both the storms of the summer monsoon and winter gales. The next visitor, who may perchance fancy he is the first on this ground, will have our annals to consult before continuing on his way. The two guides with several coolies were sent ahead to make a reconnaissance at the head of the Bolucho, and on 18th August, with regret, we took our final leave of this breezy, splendidly situated camp, which had been our home for so many weeks during two summers, and from which so much that was interesting and exciting had been accomplished, turning our footsteps for the last time down the Chogo Lungma. The day was fine, and all the well-known peaks uncovered their heads to bid us farewell. Five tent-terraces, the coolie-huts and a large pile of wood, as well as the cairn, were left behind as evidences of our visit.

It was something of a venture to take a caravan of fifty-five coolies, several servants, eight sheep, and twelve goats, up an unknown glacier and over a wild snow-range never before crossed. The Arandu lambardar remarked, it would be far easier to go down to Arandu and thence ascend the Kero nala. This was true, but the route suggested was longer and for us devoid of novelty, whereas the dash for the unknown would be over new ground full of interesting possibilities.

We reached the junction of the Bolucho with the Chogo Lungma at 10 a.m. As we needed three more coolies and some supplies, the lambardar was here despatched to Arandu to get the coolies, some sheep, fowls, and eggs. Returning he was to bring to us three boxes now left here, and follow our tracks till he found us. A Gurkha was also sent back to Riffel Camp with three coolies to fetch three sacks of ata left behind for want of carriers, and similarly follow our tracks.

The Bolucho is six miles long and averages half a mile in
width. It has no branches, being fed entirely from the mountains enclosing its upper third. It is a decadent glacier, and no longer reaches the Chogo Lungma, its present tongue having receded half a mile from the latter, leaving a deep channel from mountain to mountain covered with a vast mass of rocks, boulders, and débris thrown together in utter confusion. Judging from the great lateral moraines left at this point, the former thickness of the ice must be estimated at over two hundred and fifty feet, where none is now to be found.

The bed of the glacier was in such a chaotic condition and so obstructed that it was impossible to force a passage through it, so we led the caravan for an hour and a half up the steep, crumbling, rather dangerous, east bank, descending to the glacier, when the latter became sufficiently well marked to offer a route over its surface. It was exceedingly rough and greatly broken and was covered thickly with granite detritus. After a three hours' slow and difficult scramble over it we came to a small grass-covered spot above the west bank, where we camped. This camp, at 14,200 feet, was called Rivulet Camp because of the numerous singing mountain-streams that descended on both sides. That evening the guides joined us after two days of active work. They reported there was a fine accessible snow-col near the head of the glacier surmounted by a cornice, which they had already partially tunnelled.

The next morning we were off at five o'clock. The col was five hours distant, and we wished to cross it that day. After half-an-hour of moraine we struck the hard, moderately-ascending glacier, which had but few large crevasses and offered an excellent surface for marching. In three hours we reached the foot of the pass, where, on a snow-field just touched by the early sunlight, men and beasts breakfasted, the sheep and goats nibbling snow as complacently as if it had been grass. After this the guides led the way by the track they had
ASCENDING TO BOLUCHO COL. 7 O’CLOCK A.M.

M. Z
ON THE BOLUCHO COL.

already made up the rather steep, but not dangerous, slope leading to the col.

With the view of snowy heights expanding on all sides, it was a pretty sight to see the long line of men and animals ascending for the first time the virgin pass, which on both sides from bottom to top was an unbroken route of snow. At two badly-crevassed places we roped, but all went smoothly until the col, a narrow depression between two snow-hills, was reached at ten-thirty. Here the view, like all other views in this region, was grand, and included the giant forms of Haramosh, Indus Nagar Watershed peaks 2 and 4, Mt. Chogo, Mt. Lungma, Pyramid Peak, and others, untouched by cloud, and to the east the peaks surrounding the Kero Lungma and Hucho Alchori. While waiting for the coolies to arrive, which they did in half an hour, we took readings, which fix the height of the col at 17,021 feet.

The guides meanwhile completed a passage through the cornice, and cut steps for several hundred feet down the ice-wall below it. This wall, which dropped for about a thousand feet at an angle of sixty degrees and ended in easier slants leading to a branch of the Kero Lungma, seemed at first glance to form an impassable barrier for coolies. After heavy new snow it would have been dangerous for experts, for its entire surface was furrowed by avalanches; but the weather was now more settled, and the loose snow of the recent storms had been mostly shed to the bottom, so there was no danger on that score. Moreover, the guides had proved themselves adepts in snow and ice-craft during the season's work, and, if the coolies could be got down that wall, they were the men to do it.

A rope was anchored securely with an ice-axe in the snow above the cornice, to serve as a handhold in descending through it to the wall. It was arranged that Dr. Workman and Savoye should remain above to help the coolies through the cornice, while Mrs. Bullock Workman, with Petigax and the porter, led
the way down the wall. The passage of a cornice may sometimes be exciting. A short but perilously steep spiral gallery had been cut from the cornice around to the main slant of the wall. As she came to the bottom of this gallery, where, with one foot in the air, it was necessary to face inward and take a side-leap to the next step below on the wall, she held her breath,

for the certainty of reaching that step was not absolute, and the downward vista of the wall was appalling.

How true it is that "familiarity breeds contempt." The erratic actions of the coolies obliged her to descend the gallery twice on that day, and the second time it seemed so easy she wondered why she had almost shuddered on first negotiating it. The three then descended the wall straight, keeping the rope taut, and had gone about four hundred feet, when the two above

ON THE BOLUCHO COL, 17,021 FEET.
began to help the coolies through the cornice. With their assistance, and that of the anchored rope, five coolies passed safely through, and started down the wall. Mrs. Bullock Workman's party had, meanwhile, moved a short distance across the wall out of their immediate track, which in view of rapidly-ensuing events, was a fortunate circumstance for them. Petigax was cutting steps across an avalanche-scored couloir, when the sizzle of snow sliding rapidly down the slant just behind was heard. As they turned to see what had caused this, a coolie dashed past at lightning speed, with arms and legs in the air, in his flight grooving out the snow, which flew up in a powdery mist.

A certain guide at Chamonix is noted for making descents in fabulously short time, but this Balti coolie broke his record, glissading nine hundred feet of the wall in less than two minutes, and landing right side up, safe and sound, in the soft snow at the bottom, which was better than the guide would probably have done. Although instructed how to step and use his stick, the coolie, utterly ignorant of snow-climbing, either had preferred his own way of treading and lost his footing, or had entered voluntarily on the glissade.

This episode set the coolies, who were peering over the cornice above, to remonstrating, and, when a second one whizzed downward likewise, they became vociferous. The second, with a tent on his back was more antic than the first, and treated us to the spectacle of a series of somersaults, on completion of which he landed sprawling at the bottom, while the tent, having extricated itself from his grasp, lay an eighth of a mile below him on the glacier. The third and fourth coolies had, meanwhile, by careful treading, passed safely down the first half of the wall. The fifth blundered, and rushed past with the speed of the four winds. He carried a box of stores, which, during his rapid gyrations left his back and took its own course, ricocheting in great curves down the ice-slant. Finally it
burst, scattering like a shrapnel its contents of Bovril rations, tinned meats, jams, and Huntley and Palmer biscuits in all directions through the scintillating snow-dust.

The propitiation of the mountain gods with food-offerings was a serious matter for us, and we began to tremble for the remainder of our equipment. But other aspects of the case now demanded consideration. Fortunately the ice-gully, down which the three coolies had glissaded, had been scoured smooth of all projections by previous avalanches, and was covered by a layer of soft snow, so that they escaped unhurt. But they evidently did not fancy the abruptness of their descent, and called disparagingly to their compères above, who opened a war of words upon the Sahibs.

Mrs. Bullock Workman’s party awaited the issue, standing first on one foot and then on the other by way of resting, for sitting on snow at an angle of sixty degrees is more fatiguing than standing. Not another coolie appeared below the cornice. Presently the call came from above, “All the remaining fifty are in a panic and will not move.” Petigax replied he would return, and with the others make a new zigzag path to the bottom; but no, they would not hear of it. We were indeed in a quandary. As noon was approaching and the caravan separated, the only alternative seemed to be for all to return to the top and enter into further negotiations. It was a hot climb with the sun blazing in the zenith. When all were on the col again we called to the five coolies below, who had one tent and other effects necessary to us in camping. They replied they could not return, but would pass the night in some rocks below and descend the Kero Lungma the next day to meet us. We could scarcely ask them to reascend the wall. If we could not get the remainder of the caravan over, but were obliged to turn back, we should be put to great inconvenience in the four days before they could rejoin us.

The khansamah, who spoke Balti, was now sent to the coolies,
who sat without their loads in the snow at a little distance. We took a firm stand, saying we would go by that route and no other. They were also told the guides would remake the path, cutting it to the base, and they were promised bakhshish. While they were arguing amongst themselves and refusing over and over again to go, two hours passed, during which the guides reconstructed the entire path down the wall. This accomplished, we suggested that some of the coolies should go down without their loads and inspect the route. Two of the braver ones offered to do this. Having gone down some distance, they reported favourably on their return, and, after much parleying, persuaded the rest to take their loads and start.

Petigax led the way, while the rest of us assisted the coolies through the cornice one by one. All passed safely, though many coolies would not venture to go loaded. Several of the more courageous volunteered to aid their comrades and take their loads down the first third of the wall. In doing this they went down and up from three to five times. With infinite patience Petigax superintended the descent. By 3.30 all had passed, including the goats and sheep, which jumped composedly and with perfect security from step to step, some scorning to use the artificial path at all.

We had felt some anxiety as to how they would negotiate such a veritably high Alpine descent, but when we saw them do it, we wished that all our coolies had been goats and sheep, for had they been, a large part of the day would not have been spent in argument and ceaseless endeavour in the first crossing of the Bolucho Col. Having seen all safely on their way to the lower slope, we roped, and left the col and its cornice.

At 4.30 the entire caravan was reunited at the base of the wall, the coolies now in the best of humour at having successfully overcome the difficulties which had so greatly terrified them. Before we started for the lower part of the glacier those
who had glissaded presented themselves for medical inspection, one pointing to his ankle, another to his wrist or neck. But there was not a serious bruise, nor a sprain, nor a broken neck among them. All were in as good condition as when they started.

We were now on a branch of the Kero Lungma glacier, down which we marched in twelve inches of snow for two hours. At dusk we camped on the glacier, while the coolies settled themselves on a moraine among some rocks, where they made fires with wood brought from the Bolucho nala. As showing how little they care for any comfort that may be provided for them, may be cited the fact that they had on this tour, as on all others, tents with bottoms sewn in to keep out the cold. Instead of taking the slight trouble to pitch them, they remained the whole night without shelter.
OUR LIVESTOCK ON BOLUCHO COL, 17,021 FEET.
CHAPTER XIII.

Down the Kero Lungma—Hucho Alchori Glacier—First Bear Camp—Gurkha and Lambardar Arrive—A Floral Carpet—Second Bear Camp—Ascent to Head of Glacier—Ice-Fall Camp—Alchori Col proves to be a Cornice—Cols of Karakoram Watershed—Coolies thwart our Plans—Return to Arundu—Over Bannok La to Astor and Srinagar.

The next morning, resuming our march down the glacier, we soon reached the Kero Lungma at about the middle point of its course. From here it ascends north-west in a not difficult ice-fall to the Nushik La. We turned south-east and descended its lower half. A short distance below where we joined it an ice-fall was encountered, below which ran lines of enormous longitudinal ice-ridges, the whole covered with detritus to a much greater extent in proportion to its size than the Chogo Lungma. Large boulders lay piled everywhere. At the entrance of side-glaciers the surface was much broken into irregular elevations separated by deep depressions. Getting over it was difficult and progress slow. The glacier was so rough that, as soon as practicable, we pushed over to its right or south side, where an easier route was found along the ridge of a long lateral moraine rising some two hundred feet above the glacier, which has, evidently, diminished greatly in size in recent times. From this we crossed the great ridges and hollows to the north side of the glacier at the point of entrance of the Hucho Alchori, to explore which was our chief reason for coming over to the Kero Lungma.

Sportsmen are said to have visited occasionally the lower part of the Alchori nala, but until now the glacier, penetrating deeply into the mountains, had not been explored nor accurately mapped. Its course runs east by north from its junction with
the Kero Lungma, and its length from the latter to its source is ten miles, its width being three-quarters of a mile. Two large branches enter it on the north side, running down from the two sides of a large snow-basin, and separated from each other by a mountain mass.

The lower five miles of the Hucho Alchori resembles the corresponding portion of the Kero Lungma above described. It has greatly receded both in width and thickness, and only half-fills its original bed, the westerly half of the latter being occupied by high moraines overgrown with vegetation and bushes. The ice here runs in two high, ragged ridges, separated by a deep depression, all heavily covered with débris. The upper half of the glacier has a rolling, rather sharply-rising, but otherwise smooth surface, without much débris, ending in a steep, broken ice-fall at its highest part.

Turning into the Alchori nala, we ascended the rough, ancient moraine for two hours, when we came to a large, level maidan, lying between the high lateral moraine and the mountain, carpeted with grass and flowers, and dotted with an abundant growth of bushes about twelve feet high, which made excellent firewood. Two rivulets of pure water ran through it. It was sheltered from the wind, and made one of the most ideal camping places of the summer. Here we established a base camp at 13,150 feet, with communication with Arandu by way of the Kero Lungma.

At seven that evening the Gurkha, lambardar, and six coolies arrived, having come over the Bo luch o Col that morning. They reported that four of the coolies had glissaded the gully like the three with us, and had likewise escaped injury, landing in the soft snow at the base. One sack of ata had been lost and another provision box smashed, the remains of which, with such of its contents as could be collected, they brought with them.

The poor Gurkha, who had been forty-eight hours without
RIBBED PEAK ON KERO LUNGMA OPPOSITE JUNCTION OF ALCHORI GLACIER.
(TELEPHOTO.)
ROCK-NEEDLE ON SOUTH SIDE ALCHORI GLACIER. (TELEPHOTO.)
shelter, blanket, or any food to speak of, and had slept the previous night with the coolies in the snow at the top of the col, looked much the worse for wear, but he had stuck to his task and brought his coolies through, and came up to report, saluting as usual. The lambardar, who was a wiry fellow in the prime of life, presented himself in excellent condition. He said that, of the supplies he was bringing, a sheep, several dozen eggs, and some fowls, had been lost in the snow on the col. When questioned as to where he obtained a new pair of fine chaplies he was wearing, he said he had met a shikar Sahib who made him a present of them. It came to our knowledge a few days later that he had received of our agent in Arandu three sheep, twenty fowls and nine dozen eggs, to bring to us. A short distance above Arandu he met a sportsman and disposed of one sheep, three dozen eggs and eight fowls to him, undoubtedly receiving the chaplies as part payment for the same. These were the supplies lost in the snow.

As traces of bears were here seen, this was called First Bear Camp. A large tuft of white bear-fur was found on a bush near one of the tents, which, probably, had been lost by one of these animals in an affray with another of his species. One of the Gurkhas said he encountered a big brown bear just at dawn, which fled on seeing him. Foxes scurried about at night, but by day all animals kept at a safe distance. Judging from our experience and that of sportsmen whom we have met, it seems to us that, in Himalaya, mountains, hard as they are to conquer, afford a better bag to the mountaineer than do wild animals to the sportsman.

At this camp the topographer joined us, having come around by way of Arandu. Leaving a good part of our stores and luggage here, we marched up the nala along the west bank of the glacier in a hollow between the high lateral moraine and the hillsides. Both the hollow and the hillsides were bright with flowers. Rhubarb with brilliant red and yellow leaves and
blossoms, sorrel, large purple asters with deep yellow and orange centres, blue forget-me-nots, buttercups large and small, grass with large black flower, and many other flowering plants, unknown to us, of various hues, including a variety of deep crimson orchid, grew in profusion, forming a variegated carpet of every colour of the spectrum, that reminded us of a similar floral display in the Rangdum valley.

The mountains enclosing the lower half of the Alchori glacier
PEAK ON SOUTH SIDE ALCHORI GLACIER. (TELEPHOTO.)
SECOND BEAR CAMP—ALCHORI BRANCHES. 361

contrast with one another in a curious manner. Those on the side we were on—the north side—have gentle slopes and are clothed with grass almost to their tops, which are rounded, while those on the south side rise precipitously from the glacier, terminate in some very sharp needles, and have much snow on them. After two hours and a half of flower-strewn path, the hollow ceased, and we followed the top of the lateral moraine, which towered far above the surface of the receding glacier. At noon we reached the first of the two branches, which was crossed in three-quarters of an hour. Surmounting a high lateral moraine we descended from it to another large, gently-sloping, sandy maidan, lying at the junction of the two branches with the main glacier and enclosed between the mountain dividing them and the semicircular moraine we had just crossed. Several streamlets flowing from the mountain above crossed the maidan. This furnished a safe and convenient camping ground in the very heart of this ice-region, and was the last spot found that was not snow-covered. Numerous traces of bears were also observable here, which suggested the name of Second Bear Camp. Its altitude was 14,283 feet. Both this maidan and the one below, on which stood First Bear Camp, are perfect examples of the maidans described in Chapter VIII. of this book.

The two branches entering at this point, each about three miles in length, are broken into steep, much-splintered ice-falls throughout their entire course. The snow-basin in which they rise and the jagged peaks above it are wild to an extreme degree. There are cols, which doubtless overtop the Hispar glacier, but they are quite inaccessible on account of the steep rock-walls and terrific séracs below. At the east branch stands a stately snow-peak, the upper slopes of which would probably be climbable did not the ice conditions lower down prohibit such an attempt. The main glacier, instead of running due east as on the Survey map, shortly above this camp makes a decided turn
to the north, and, ascending between lines of sharp aiguilles, culminates in a beautiful snow-col overhanging the Hispar glacier.

On the morning of the 22nd August we left camp with twenty-five coolies to explore the glacier to its source. Crossing over to its east side, we continued up its smooth, undulating surface for three hours, when we reached the base of an ice-fall stretching entirely across the glacier, and barring the way like a frozen cataract. The caravan, with some assistance, surmounted this, and kept on up the steep snow-fields above, until confronted by another similar barrier composed of great masses of ice and névé separated by wide transverse crevasses. Examination showed this to be entirely impassable at any point except, possibly, near the west side of the glacier.

The caravan was with some difficulty led across to that side, when, alarmed by the fall of several snow-caps, that, softened by the hot sun, slid off from the séracs into the blue abysses around, they refused to advance farther. While the coolies were talking and gesticulating among themselves, the guides discovered, a short distance beyond, a steep narrow couloir running up between a tall sérac and a crumbling mass of snow, under clusters of icicles, to a point behind, from which firm snow above could be reached by cutting steps around the side of the sérac. The passage was a ticklish one, and we were put to considerable trouble to induce the coolies to attempt it, but the all-powerful bakhshish finally settled the question in our favour, and by free use of the rope they were hauled one by one up the steps, which to them were the most alarming part. This accomplished, we kept around the edge of the basin, crossed two crevasses, and, having had a three and a half hours' exhausting contest with the dangerous portion of the route, emerged on a fine, high snow-expanse, at the top of which, directly under the col aimed for, we pitched our camp at an altitude of 17,002 feet, and named it Ice-fall Camp.
ANIMALCULES AT ICE-FALL CAMP.

To our delight a small rill of water was discovered coursing down a perpendicular rock-face near by, resulting from the melting of snow on the rocks by the fierce heat of the sun. Running water is seldom found at such an altitude. All haste was made to fill every available receptacle before the freezing night-temperature should silence the cheery cascade. A curious phenomenon was here noticed. In melting snow later the resulting water was covered with small, grey, gelatinous animalcules of various shapes, which moved actively and waved small projecting parts. How these organisms managed to ascend to a height of 17,000 feet, to be deposited in the snow, and to retain their vitality, is a mystery we do not attempt to explain, but for the fact we can vouch.

A gorgeous vermilion sunset illumined the line of peaks rising from the darkening glacier stretching away below our terrace, after which the cold, darkness, and deathly silence of the uninhabited snow-world fell upon the camp like a curtain. But in such a camp, when it is not too high and the coolies are not too near, one sometimes sleeps a dreamless sleep not vouchsafed in inhabited places, and we seemed scarcely to have touched our pillows when the guide was heard calling, "Four o'clock."

At five Mrs. Bullock Workman and the guides left to find a way to the col. A snow basin above the camp was crossed, and a number of avalanche-beds also, to a very steep snow-wall, down which avalanches had been raining the previous day, but which now stood silent in the dull light of a frozen dawn. A zigzag path was cut up its central face, at the top of which several large rock-battlements were reached. These furnished some gymnastic work, which had the advantage in the nipping sunless air of restoring sluggish circulation. Then followed névé which led to the col, another projecting cornice.

It had been hoped a practicable pass might be found, over which the caravan could be taken to Hispar, but, far from this,
the party had to content themselves, as on the Col des Aiguilles, with stepping out singly on the shelf and looking down thousands of feet upon the broad expanse of the lonely Hispar, winding its way towards the sun-baked vale of Hunza Nagar. This differed from the other cornices met with, in that for nearly half its length it took the shape of a reversed cornice, its edge turning back like a white fluted ruffle. This was undoubtedly the result of some eccentricity of the wind, or of the meeting at the edge of two currents, and might not exist at all another season. This was named the Alchori Col. Its altitude is 17,622 feet.

Photographs were taken of a large unnamed north branch of the Hispar glacier directly opposite, leading from the latter to Snow-Peak No. 4 of the Survey, 25,503 feet, which stands on the confines of a region as yet unexplored and unmapped. West of this rises Peak 2, 24,593 feet, which feeds the Kanibasar glacier. The towering ramparts of these two giants cut off all view of the unsurveyed world beyond, but their icy splendour was a partial compensation; for a grander scene than this is rarely found. In handling the instruments without gloves Mrs. Bullock Workman nearly had her fingers frost-bitten, but this was not realised until on descending they began to be painful. The sun does not touch the col on the upper part of the Alchori till 9.30 a.m. in the latter part of August. Both the ascent and descent were made in the shade, the temperature of the air being below freezing. Leaving Ice-fall Camp at ten, Second Bear Camp was reached at 3 p.m. On the return the coolies made light of the difficulties they had groaned over on the upward march.

As regards the Karakoram Watershed south of the Hispar glacier, it may be said, in the two expeditions described in this volume, we attacked it repeatedly, partly because the glaciers we were exploring culminate in its cols and passes, and partly because we had a hobby for finding a new caravan-
ICE-COULOIR AT HEAD ALCHORI GLACIER, UP WHICH CARAVAN WAS TAKEN.
ICE-FALL CAMP, 17,002 FEET, AT HEAD OF ALCHORI GLACIER, ALCHORI COL BEHIND.
passage over it, with the following results. The cols at the head of the Sosbon and Hoh Lumba glaciers are separated from the Hispar by a glacier and a high mountain ridge. These cols, as has been shown, are corniced, and overhang perpendicular precipices several thousand feet in height. Next to the west, following the range, comes the Alchori Col just described, difficult of access from the south and falling to the Hispar by a precipice on the north. Then the cols above the two branches of the Alchori also overhang the Hispar, but are
inaccessible from either side. From the Kero Lungma two glaciers that might lead to the Hispar were found also to be inaccessible. Next in order is the Nushik La, a practicable pass but one seldom crossed in the last twenty years. From the upper tributaries of the Chogo Lungma we ascended two high
cols, which proved to be impracticable as passages. The Chogo La, at the head of the Chogo Lungma, would furnish a passage to the west, probably to Hispar, to a party of thoroughly equipped mountaineers, but it would not be avail-

able for coolies on account of the long and difficult march up the Chogo Lungma and the great ice-wall at its head of nearly 20,000 feet. The same is true of the Haramosh La, at the head of the Haramosh glacier, leading to the Indus and Gilgit.

We have thus climbed or thoroughly examined twelve depressions in the ranges of this region, and have failed to
discover any other available route from it to the north or west than the Nushik La, which is the only one over which a caravan could be taken. Our researches have also shown that the northern slopes of this watershed are more precipitous than the southern. Such of the cols as were accessible at all proved to be so from the south side only.

After finishing with the Alchori we had planned to reascend the Kero Lungma, cross the Nushik La, and descend the Hispar glacier to Hispar and Nagar, and return via Gilgit, which would enable us to complete our exploration of the region by investigating its northern approaches. We had the necessary permits; the Hunza Nagar chiefs had been notified of our intended visit by the Kashmir Government; we had provided a large supply of food for the coolies, and our own arrangements were complete.

On our return to Second Bear Camp, this intention was communicated to the coolies through the lambardar. The effect was like the application of a spark to a powder-magazine. An explosion followed at once. The coolie-camp was thrown into an uproar, and the sound of loud and excited voices filled the air. Not a coolie would go with us. The same afternoon ten deserted. Arguments, assurance that the route was easy, and, on arrival at Nagar on the fourth or fifth day, they would all be paid off and might return immediately, and the offer of four times their daily wages, had no effect. For the second time in a fortnight they were deaf to all inducements. The proposition had evidently touched a tender point, which at the time we could not fathom.

The next day we returned to First Bear Camp. Here the lambardar was told to select eight coolies to go with the guides to examine a branch of the Kero Lungma. He reported no one would go. A call was made for volunteers. Not one responded. The mere mention of Nagar two days previously had transformed the whole band. They were evidently afraid, that the order to go with the guides even upon the Kero
SECOND BEAR CAMP, 14,283 FEET ON MAIDAN, HUCHO ALCORI GLACIER.
Lungma was a trap, into which they did not intend to walk. They said they would take us back to Arandu but would go nowhere else. They were willing to lie around doing nothing at First Bear Camp, receiving food and wages from us, but nothing in the way of work would they do except to take us back to Arandu.
We learned later from an official, who knows them well, that the Basha people have a mortal fear of the warlike Hunza Nagar tribes, who, before their conquest by the British, used to make raids over the Nushik La and plunder the Basha villages, and nothing would induce them to put their heads in the lion's mouth by crossing the Nushik La. While this explains the otherwise unaccountable attitude of the Basha coolies, with whom we had previously had no trouble except that due to
SUMMIT NANGA PARBAT, 26,620 FEET. TELEPHOTO FROM BANNOK LA, 25 MILES WEST.
VIEW WEST DOWN HARPO NALA TOWARDS NANGA PARBAT.
their cowardice and frequent desertion in the face of difficulties, it did not console us for the loss of a month of what would have proved most interesting and valuable work. We had to accept the situation as one of the exigencies of exploration.

One morning, while at this camp, we crossed the glacier and ascended a rounded summit of 15,000 feet altitude, wooded on its lower slopes, and covered with grass towards the top. The interest of the trip lay in the glacier itself, which, although so much shrunken, carries the enormous ice-ridges mentioned with deep valleys between, containing rivers the size of mill-streams which have cut channels deep into the ice, lakes, and large blocks of granite besides other detritus, all of which, together with its lateral moraines, a hundred and fifty or more feet in height, made crossing it a rough scramble by no means devoid of danger. On the mountain-top was a long line of chicor-nests hollowed out in the dry earth on a crest commanding a view of all approaches.

After some days at First Bear Camp, we returned in fine weather to Arandu on 9th September. At the junction of the Alchori with the Kero Lungma, we crossed some of the highest ice-slants anywhere met with, one being two hundred and fifty feet high from the bottom of the valley between it and the next. From the tongue of the Kero Lungma the route runs down the nala for two miles to a pasturage called Domok, below which the end of the Niaro glacier has to be crossed, a short glacier, but having ice-hillocks, and slants quite as high as those on the Kero Lungma. These small glaciers often have very large ice-hills with deep valleys between.

The Kero nala from here to the Chogo Lungma is narrow, and its sides steep and composed of moraine-detritus through which the stream has cut its way. The path through the nala is very rough, and during or after rains may be dangerous on account of falling stones or landslips.

On 18th September we left Skardo to return to Srinagar via
the Bannok La and Astor. Fifty-four coolies sufficed to carry our luggage. After an eight hours' march down the Indus valley, here wide and sand covered, we reached Katsura, a village prettily situated a short distance up a side-nala, where we camped in a grassy bagh sprinkled with boulders and shaded by apricot and willow trees.
THE LEADERS OF THE EXPEDITION.
From Katsura, a march of eight and a half hours up a path rough with rocks and cut by streams, brought us to Shagerthang at an altitude of about 11,550 feet, in a wheat-raising region without fruit trees, surrounded by mountains of shale, granite, and basalt, dotted with arbor vitae trees. Two hours' farther is Thlashingspang, where there is wood, water, and a good meadow to camp on. Leaving camp early, we marched three hours up the valley and then two hours over stones and moraine, when snow was reached. Mounting now over hard snow without crevasses up two snow basins surrounded by rock-peaks, we gained the top of the Bannok La, in the second basin at 1 p.m. The height of this was estimated from readings at about 16,500 feet.

The massif of Nanga Parbat and its lower satellites, thirty-five miles to the west, are remarkably well seen from this pass. About the base of Nanga Parbat rise several lines of peaks graduated one above another, which, purpling in the afternoon light, recalled the beautiful view of the intermediate ranges between Darjeeling and the snows. On this day the air was wonderfully clear and details were distinctly visible.

The Bannok La, though far less difficult to cross than the Trongo Pir, is more interesting on account of this view. A descent of three quarters of an hour over a snow-field, succeeded by one over moraine and screees, brought us into the descending meadows of the Harpo nala, brilliant with autumn tints. Still lower came trees, birches and pines, and a variety resembling alders. The routes from the Harpo La and Trongo Pir also enter the Harpo nala.

On 23rd September Astor was reached at 9 a.m. The next morning our guides left us to return to Srinagar en route for Europe, and some days later we followed leisurely, reaching Srinagar on 9th October.
CHAPTER XIV.

Coolies as a Factor in Himalayan Mountaineering—Relations of Employer to Coolies—Difference in Coolies—Capabilities—Shikaris—Dilemma in which Explorer is placed—Management of Coolies.

A vital question in Himalayan travel and exploration is that of transport. In many, especially in the more remote regions, coolies furnish the only means of transport. As such they constitute a factor, that has to be taken into consideration in planning any expedition, for without their assistance it cannot be undertaken.

A knowledge of their character and habits is of great importance to the explorer, in order that, having obtained the desired number, he may know how to use them to the best advantage, and how far he can push them in carrying out his plans and yet retain them in his service. He learns in time, that they are what they are and he cannot make them what they are not.

Like so-called civilised human beings they have their good and their bad side, their virtues and their faults, their capabilities and their limitations. They will usually do what they are accustomed to do or what appeals to their sense of personal advantage, with readiness, but when called on to perform extraordinary services, which conflict with their prejudices or inclination, they respond much less readily.

They are supplied on request by the lambardars or other head-men, who exercise a certain indefinite authority over them. Just how far this authority extends we have never been able to determine, but we judge it to be more nominal than absolute, from the fact that, on more than one occasion, our servants have been obliged to drag out unwilling coolies from hiding-places in which they had concealed themselves to escape the service
to which they had been appointed by the lambardar. Whatever positive authority the head-man may have, one thing seems to be recognised, at least in Kashmir and its dependencies, that coolies cannot be compelled to perform any labour outside their own district.

The traveller is expected to pay his coolies a certain sum regulated by custom, though native officials are said to exact gratuitous services from them. Whether they be paid in person or through the head-men, it is doubtful how much of the amount paid remains to them for their own use, owing to the Indian system of dastur, in accordance with which the head-men and sometimes even the travellers' own servants retain a part for themselves.

The services rendered by coolies to the traveller consist in transporting his effects and supplies, assisting him in pitching and striking tents, fetching wood and water, and acting on occasion as messengers. So long as he is passing through inhabited districts he is not likely to have much trouble, and can usually count on all his luggage being delivered to him at the end of the day. He has personally but little to do with his coolies. A given set go only one day's march with him, or from one village to another, at the conclusion of which they are paid off and replaced by others.

In case the traveller happens to be an explorer or mountaineer, when he reaches the limits of human habitation his relations to his coolies assume a very different aspect. He no longer requires them for a single day, but must have a permanent corps, to go with him for weeks or months. He is taking them away from their homes and occupations into inhospitable, perhaps unknown regions, peopled, it may be, by their fancy with harmful spirits, whose wrath they fear to encounter, regions in which they have no interest, and where, in spite of all provision made by him for their comfort, they have to endure more or less of privation. They have no understanding of nor sympathy with his object.
in thus leading them into a desolate wilderness, and probably regard him as an insane enthusiast. Under these circumstances it is not surprising that coolies often prove to be troublesome employees.

It is advisable for the explorer, if possible, to take with him only those who, induced by the terms he may offer, may volunteer to go, but even in this case he cannot feel sure they will hold to their agreement. They have little moral sense and as little regard for their pledged word, or for any contract they may make and ratify with their thumb-marked signatures, which they will break without scruple as soon as difficulties are encountered, and often before, deserting and leaving their employer with his outfit and supplies without means of transport.

Those who have employed coolies under ordinary conditions at low altitudes and found their work satisfactory, would have quite another story to tell, had they attempted with the same coolies to force their way along the ice-clad peaks of the higher mountain regions.

A lambardar should be taken in charge of the coolies, as his influence and authority are valuable in keeping them up to their work. When a defection among them does occur, it is usually at a critical moment, when the prize may be dashed from the hand that after months of patient effort is stretched out to secure it.

The hold of an explorer on his coolies is almost as much a moral as a pecuniary one, and much tact is required to keep them in hand if strenuous work is to be done, such as exploring a crevassed glacier or ascending a high snow-peak.

Coolies are by no means all alike. Some render much better service than others. Of those we have had experience with, the Sikhim coolies are the worst, their natural imperfections having been accentuated and others acquired by long contact with Europeans at Darjeeling. Not only do they demand four times
the wages received by West Himalayan coolies, but for an expedition they also demand an elaborate outfit of clothing and

provisions, where the latter supply their own clothing, and are satisfied to live upon rice or ata. They refuse to start in the morning till they have cooked a complicated hot breakfast, thus causing the loss of two or three of the best hours of the day;
and, when they do march, cover only a third the distance accomplished by western coolies.

They will desert without reason or warning, leaving their loads on the roadside, a thing rarely known in the west. Coolies who will leave invalids, as they are said to do, helpless on Darjeeling roads, and who require the whole authority of Government officials to prevent their deserting on expeditions, are not suited to the requirements of the explorer or mountaineer.

Kashmiri coolies are but little better. Many and bitter are the complaints one hears of their treatment of summer visitors within thirty miles of Srinagar. The best natured and most willing coolies we have employed have been Ladakhis, while the Baltis occupy an intermediate place, some being good, others bad. Some of the Balti characteristics have become apparent in the course of this narrative. With the more manly and warlike border tribes, such as the Hunza Nagar men, we have had no experience. They are said to make excellent carriers, when they are willing to act in this capacity.

As far as the capability of the different coolies of Kashmir for mountain work is concerned, after an experience of five expeditions with them, we can say we have found them well able to make their way on steep and even dangerous mountain-sides below the snow-line. They are sure-footed and, as a rule, fearless, and seem to possess something of the instinct of mountain animals. In climbing lower mountains they may make helpful companions.

Above the snow-line and on glaciers the case is different. Here their want of knowledge of snow-craft is at once apparent, and they move with an awkwardness and a timidity which makes one disinclined to have them on the rope. Notwithstanding this, probably from ignorance of mountain conditions, they show an utter disregard of danger from avalanches, both of snow and rock, and on different occasions while with us have persisted, in
COOLIES AND SHIKARIS AS MOUNTAINEERS. 403

spite of earnest warnings, in placing themselves in positions of great peril from this cause.

They are also liable to be affected with mountain-sickness, which renders them much less valuable than they might otherwise be. Every one of eight coolies, who have accompanied us to summits over 18,000 feet, have been more or less affected with this malady. On rocks we have never had to help them, but on snow and ice, not only much help, but also much persuasion and promises of bakhshish have been required to get them over places that to us presented no difficulty. We have probably led coolies over as many difficult places on ice and snow as anyone, but we should have no confidence that the same or other coolies could be induced to pass these places a second time.

The same is true of shikaris, who differ from coolies only in being somewhat more intelligent and unwilling to carry loads. They are employed mostly by sportsmen visiting the nalas of the lower mountains, whose inexperience they take advantage of to impose on them in a variety of ways known to the initiated. On mountain expeditions we have found them useless, and their influence over the coolies has been pernicious.

In the light of our experience, we cannot endorse the comparisons which have been made of the mountaineering capacity of coolies and shikaris on snow-peaks to that of expert European guides. Such comparisons do not conform to fact, and indicate, to say the least, a want of knowledge of difficult snow-work on the part of those making them. Five minutes' observation of the movements of a trained European guide and of a Himalayan coolie on an ice-slope suffices to show their absurdity.

Within a few years two Kashmiri shikaris, whose application for service we declined, though they presented flattering testimonials as to character and mountaineering ability from a self-styled "guideless climber" on his first visit to Himalaya, were employed by a traveller as companions in an attempt on a
404 ICE-BOUNDED HEIGHTS OF THE MUSTAGH.

snow-peak. The attempt failed. The traveller reported that they were ignorant of snow-craft and of the use of the ice-axe, refused to ascend moderately steep snow-slopes, and discouraged his coolies, when he wished to make a high camp. This report corresponds to the known character of them both.

The limitations of coolies on snow and ice and their disinclination to go on these, place a heavy handicap on the mountaineer who wishes to attain great altitude. Great altitude cannot be reached without camping high. As matters now stand, to take coolies higher than they have gone will probably be found a difficult undertaking, at least in the Western Himalayas.

In the present unregulated state of affairs in Kashmir, the prospects of further important work among its grand mountains being accomplished in the near future by private expeditions are not encouraging. The Durbar takes no interest in mountaineering science, and does not seem disposed to encourage efforts to promote it. The transport question constitutes a serious obstacle. Coolies, who must furnish the transport means in the higher and many of the lower regions, have, during the last few years, become self-assertive and contemptuous of such authority as is exercised over them. They are unreliable; any contract they may make with the explorer is, as already stated, worthless, and, in the absence of a contract law in Kashmir, they cannot be held responsible for breaking their faith. Even if there were such a law, the attempt to enforce its penalties upon a gang of recalcitrant coolies would be like trying to enforce the provisions of a law upon a pack of wild animals in a wilderness.

The mountaineer is placed on the horns of a dilemma. If he be so unfortunate as to secure a parwanah, or order from the Durbar to the inhabitants to assist him, a host of minor officials along his route, who are empowered to act in his interest under its provisions, proceed to levy contributions on the people, ostensibly for his use, but really for their own aggrandisement,
DILEMMA OF EXPLORER.

which are never paid for, of which he knows nothing, and from which he receives little or no benefit. This creates a sort of reign of terror along his route. The villagers flee on his approach, hiding such supplies as remain to them, and his reputation suffers in consequence of actions of which he is entirely innocent. All this renders such coolies as are supplied him suspicious of him, and ready to desert at the first opportunity. Under such circumstances effective scientific investigation, even if he reaches his field of operations, is almost impossible.

He is equally at a disadvantage if he has no parwanah. No authority stands behind him, and he has to make such arrangements as he can, at a high price, with coolies who have no conception of common honesty, and whose word cannot be depended on for an hour. It is not uncommon for coolies after a few days' service to ask for payment before the time agreed on, and, in case of compliance with their request, to decamp forthwith, regardless of their pledges or the interests of their employer. Not only does their desertion seriously derange the plans of the latter, but the falsehoods they circulate regarding him on their return prevent him from readily replacing them. The impunity with which such acts can be committed is likely soon to interfere materially with the course of ordinary travel in Kashmir.

Certain philanthropically disposed persons, having little or no knowledge of coolies under the conditions here considered, talk of the efficacy of kind treatment—which means coddling and making companions of them—in inducing them to remain faithful to their agreements. We do not wish to be understood as advocating harsh treatment of coolies or anyone else. Far from it. But our experience leads us to agree with those who, having had much to do with coolies under varying conditions, regard this idea as mere sentimental nonsense.

It has been said to us time and again by those long in the
Indian service, and we have had every reason to believe it to be in general true, that the coolie understands only the application of superior force as an incentive to fulfil his obligations. Gratitude he does not know. Kindness he does not appreciate nor reciprocate, and ordinary motives of personal advantage, as understood by Europeans, do not always appeal to him. He is an Asiatic, unswayed by those principles which regulate the conduct of conscientious Europeans. It is not necessary to treat him harshly, but he must be handled with firmness. Either you must master him or he will master you. He knows no middle ground. The more kindness you bestow on him the more will he attempt to impose on you. He will accept all your favours without thanks, and the next day he will leave you in the lurch, and steal from you if he can.

The principle of equal privilege for all cannot safely be extended to him, as has been abundantly shown during the past few years by the evil effects of the doubtless well-meant efforts to improve his lot, not only in Kashmir, but also in India, by relaxing the conditions under which he serves the public. The more these have been relaxed the more unreliable has he become, and the less efficient his service. Not being able to comprehend the value of privilege, he has prostituted it to base ends, to the detriment of the position of the Anglo-Indian, as is apparent to those conversant with the trend of Indian affairs during the last ten years. The coolie has been unduly elevated, the public interest has suffered.

In Kashmir the system of begar, or forced labour, by which the Government can at any time call upon coolies to render services for which they are not any too well rewarded, and the custom of dastur, or graft, in accordance with which officials deprive them of a large part, sometimes the whole, of the proceeds of their labour, are doubtless largely responsible for their shifty, untrustworthy character.
CHAPTER XV.

Importance of Altitude-Measurements—Mercurial Barometer—Hypsometer—Uses and Limitations—Aneroid—Liable to Index-Errors—Useful when properly Checked—Experiments with Watkin Aneroids—Shut-off Feature of Questionable Value—Different Aneroids develop Different Index-Errors.

The measurement of Himalayan altitudes is a subject of special importance in view of the facts, that many of the peaks of this chain are higher than those of any other chain in the world, that they are more and more attracting the attention of mountaineers, that altitudes have already been reached on them that are not elsewhere possible, and that they alone afford an opportunity to solve some interesting questions pertaining to man and altitude.

This subject has hitherto received from Himalayan travellers less attention than its importance demands. Many statements as to the altitude attained have been made, which are wide of the mark, based on mere guesswork, or on estimates from readings of instruments of imperfect construction, or not in a condition to record pressures correctly, or from readings at the points specified only, without regard to other conditions essential to proper determination. In the interests of science and of a spirit of fair play towards those who are labouring in the same field, where every extra hundred feet of altitude is gained at the expense of strenuous effort, one cannot be too careful to use every available means to fix the altitude reached as correctly as possible.

To do this with an approximation to exactness with the means at the command of the mountaineer is in many parts of Himalaya a difficult matter. Leaving the theodolite out of
account as unsuited to his use, he has to rely on the mercurial barometer, the hypsometer, or the aneroid, the readings of which can only give reliable results when compared with readings of similar instruments taken at the same time, or nearly the same time, at a convenient lower station, the height of which is known. Such stations are rare in Himalaya, and, until more extended scientific surveys have been made, aside from the peaks already fixed by the Indian Survey, the altitude of many others, which may be attempted, will have to be estimated by single readings uncompered with readings at a lower station, which estimates can only approximately represent the true altitudes.

Single readings of reliable instruments at different times at the same point may indicate for it altitudes differing from one another by 1,500 feet or more, according as the pressure may be high or low. This is true of instruments at sea-level. The highest of 252 consecutive readings of the Government mercurial barometer at Skardo during the summer of 1903 indicated for it, without comparison with readings at any lower station, an altitude of 7,268 feet, the lowest that of 8,088 feet, a difference of 820 feet. Hence it is easy to see how, in the absence of lower station readings, inaccuracies in estimating altitudes may arise. One person reaches a given point at a time when the atmospheric pressure is low, and from the reading of his aneroid or hypsometer estimates its altitude at 20,000 feet. Another visits the same point when the pressure is high, and estimates it at 18,500 feet. Neither gets the true altitude, which lies somewhere between the two estimates, but probably does not coincide with their average.

Each of the three instruments above mentioned possesses certain disadvantages, which limit its field of usefulness. From the nature of its construction and its fragility, the mercurial barometer is not adapted to the exigencies of mountain exploration. It is cumbersome, and easily broken.
PEAKS ON KERO LUNGMA OPPOSITE AICHORI GLACIER. (TELEPHOTO.)
Its more portable forms have not been brought to such perfection as to ensure the degree of accuracy, combined with simplicity of manipulation, which commends it to mountaineers in the trying circumstances in which they often find themselves. They are therefore forced to discard the mercurial barometer in favour of the hypsometer and aneroid, which possess the great advantage of portability.

The value of the hypsometer depends on the correct scaling of its thermometers. If these have been tested and found accurate, or their errors determined, there is no reason why this instrument should not be as reliable as the mercurial barometer. It can be used at all camps and on mountains when there is no wind, or when a shelter from the wind can be had. It cannot be used at points exposed to wind, or deeply covered with soft snow, or where the nature of the terrain is such as to afford no convenient resting place, as on a sharp slope. Neither could any form of mercurial barometer well be employed under such conditions. With these exceptions, the hypsometer is always ready for use without any tedious and often impossible manipulations such as are necessary to the employment of the George barometer.

Another drawback to its use at high altitudes should be mentioned. Above 17,000 feet alcohol does not ignite so readily as at lower levels, and requires contact with a match for some seconds before it will burn. At 20,000 feet, where the air is said to contain only about half as much oxygen as at sea-level, the lamp of the hypsometer shows itself quite as sensitive to the diminution of this element as a human being. It obstinately refuses to ignite inside the hypsometer jacket, and when lighted outside of this and placed within it promptly goes out. Rectified spirit, or still better, absolute alcohol, should be used at high altitudes to ensure ready ignition and supply sufficient heat to boil the water.

The aneroid, depending as it does on an exceedingly delicate
mechanism considerably more sensitive to jars than that of a watch, can scarcely be called an instrument of precision under the conditions in which it is used by the explorer or mountaineer. While a good aneroid, when at rest, will perform its work perhaps as well as a mercurial barometer, when carried about and subjected to the motion and jarring which it must receive on an expedition, it will develop index-errors, which render its readings unreliable.

These index-errors, in our experience, do not remain constant, but vary according to the kind and degree of motion brought to bear on the aneroid. They may be positive or negative, or may change from one to the other. We have seen them developed to the extent of three inches by severe jars, such as those caused by step-cutting, a jump, or a fall. A jar which a watch will stand with impunity, may cause a decided permanent deflection of the index of an aneroid.

Comparing an aneroid with a standard barometer before leaving and after return is of little, if any, value, as under the rough usage to which it is necessarily subjected during distant expeditions in mountain regions, it is almost certain to develop index-errors, which errors are as certain to vary from time to time. Its reading, therefore, on return is no indication of the correctness of its readings at different stages of the journey. In consequence of these errors the aneroid, when used alone, cannot be relied on to measure altitude accurately, and is of comparatively little value for this purpose, as various reports of aneroid eccentricities testify.

Employed, however, in connection with a reliable barometer or hypsometer, by which its index-errors can at any time be ascertained, and properly read, it is a useful instrument, and may render important and, apparently, quite reliable service, where the hypsometer cannot be used. 1 A moderate index-

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1 As aneroids are scaled by different makers with zero varying from 30 to 32 inches, it is obvious that the scale of feet on them varies
error is of no great account if one has the means of determining it. In spite of such error, an aneroid in good working order, if carefully carried, may register with considerable accuracy the difference of altitude between two points, its reading and the temperature being noted on leaving the lower point and on arrival at the upper one.

One of our Watkin aneroids, used as an ordinary aneroid without reference to the shut-off feature, thus indicated a difference between two fixed points in the Alps of 3,500 feet, the measured difference being 3,509 feet. Again, a difference between two others of 1,875 feet, the measured difference being 1,880 feet. The small discrepancy shown might be due to inability to read with absolute accuracy, owing to the closeness of the aneroid scale, or to a lack of coincidence in the position of the recording instruments, or to a slight change of atmospheric pressure during the ascent to the upper points. An error from this last cause would be likely to occur during an ascent requiring several hours, but at great altitudes this might fairly be discarded.

If, therefore, the altitude of a high camp be established by hypsometric readings compared with simultaneous ones at a fixed lower station, and an ascent of a peak be made from that camp, in case the hypsometer could not be used at the summit of the peak, it would be legitimate to consider the altitude of the latter to be that of the camp plus the difference shown by the aneroid readings, especially if, on return to camp, its index corresponded to its position before departure. Still more reliable would be the result obtained by comparing the aneroid reading at the summit, corrected for index-error with a simultaneous reading at the camp or lower station.

also. Hence another cause of discrepancies in the altitude of a given point when registered at the same time by different aneroids read by the scale of feet, as many mountaineers are in the habit of doing. Readings, to have any claim to credence, must be made by the scale indicating the pressure of the air as expressed by inches.

M. E E
Under a variety of conditions the aneroid, which can be read quickly anywhere, fulfils a purpose which no other instrument is capable of doing, and, as an adjunct to the hypsometer, is, under proper control, a valuable instrument. Independently of index-errors, it also serves a most useful purpose in determining changes in the weather. Two or more aneroids should therefore be included in the outfit of the mountain explorer.

We carried with us two hypsometers, each with two tested thermometers, two three-inch three-circle Watkin aneroids scaled to 24,500 feet, one latest pattern three-inch Watkin mountain aneroid, with arrangement for putting it into and out of action, scaled to 25,500 feet, and a three-inch Hicks aneroid, scaled to 18,000 feet, which naturally played no rôle above the limit of its scale.

The directions given with the Watkin mountain aneroid are to allow one minute to elapse after turning it into action, and then read, the understanding being that at first its reading will be one tenth inch too high, but after a minute the index will settle to its proper position.

Before putting this instrument to practical use a large number of observations from sea-level to elevations of 5,200 feet were made to determine the value of its distinctive feature, the apparatus for throwing it out of and into action. All four aneroids were set by a standard barometer and kept under exactly the same conditions. The readings of the other three were used to check the one tested. It was found, on putting the last out of action for periods varying from ten minutes to twenty-four hours, when restored to action it showed plus index-errors of from three to seven tenths of an inch.

During the first minute the index fell about one tenth inch, as the maker stated it should; during the second minute about one thirty-sixth inch, after which its movement became imperceptible to the unaided eye, although it continued to fall. A
SHUT-OFF FEATURE UNRELIABLE.

period of several hours was required, twelve to eighteen and longer, to restore it to accord with the other aneroids.

The result in all observations was invariably the same, the length of time necessary for the index to assume its proper working position varying in general with the time the aneroid remained out of action. The aneroid was returned to the maker to be examined, but nothing amiss was discovered. Today, after five years of use, during which time it has been examined and tested by the maker three times, and found to correspond with his standard barometer throughout its scale, it works in exactly the same manner.

As this aneroid was thus found to be unavailable for immediate reading after being put into action, we never made use of this feature of it on expeditions, but employed it, like any other aneroid, with the index always in action, in which condition it worked consistently and gave about as good satisfaction as the three-circle aneroids, though the latter, having a more open scale, are more sensitive to changes of pressure.

During the summer of 1903, while we were delayed for two days at a snow-camp on the Hoh Lumba glacier at an altitude of 15,000 feet, it was thrown out of action for twenty-five minutes. On being restored to action the index showed a plus error of six tenths inch, which after fifty hours still stood at two tenths inch, the control aneroids having meanwhile fallen one tenth inch. Whether that error was ever reduced to zero, our further movements prevented us from ascertaining.

Afterwards in London, by the kindness of Mr. J. Hicks, the maker, who placed at our disposal a new four-and-a-half inch Watkin mountain-aneroid, we were able to make further observations, of which the following are typical:—Obs. 1. Aneroid put out of action for five minutes. On restoration, index showed plus error of eleven one hundredths inch. During first minute it fell two one hundredths inch, not one tenth, as it is supposed
to do. It returned to its normal position in two hours, forty-five minutes. Obs. 2. Out of action one hour. When restored, index showed plus fifteen one hundredths inch. During first minute index fell four one hundredths inch. At end of six hours, error of plus four one hundredths inch still existed. Obs. 3. Out of action twelve hours. When restored, index-error was plus sixteen one hundredths inch. During first minute index fell three one hundredths inch. At end of ten hours agreed with that of control aneroid.

These are experiences with only two Watkin mountain- aneroids, but, as these were made by a manufacturer of high reputation and declared by him to be perfect in construction, and as the second was made four years later than the first, which bears a number well into the second hundred of its series, their distinctive shut-off feature presumably represents the same feature of other similar instruments.

These results, and like ones which have been observed by others using the Watkin aneroid, throw suspicion on the accuracy of readings taken in this manner with aneroids of this class, and suggest the desirability of further investigation of the working of this arrangement. Every possessor of a Watkin aneroid can satisfy himself of its value in case of his own instrument by repeating these observations.

After starting on this and the following expedition, the four aneroids, which when quiet read well together, although handled with every care and, so far as possible, subjected to the same conditions, developed different index-errors, even when there was little change of altitude; and it was seldom that three of them read alike. The extremes of difference often amounted to five tenths inch and sometimes to seven tenths. Altitude did not appear to influence the index-errors as checked by the hypsometer; they averaged as well in this respect at 19,000 feet and above as at 5,000 feet. The two which proved most reliable always showed plus errors above
DISAGREEMENT OF ANEROIDS.

17,000 feet except on one occasion, when one of them had a slight minus error. This last circumstance is interesting in connection with Mr. Whymper's observations on the loss of aneroids of an older type as compared with the mercurial barometer under diminished pressure, indicating possibly an improvement in construction.

Further observations with these two and a new three-and-a-half inch aneroid scaled to 25,500 feet recently made for us by Mr. Hicks, all of which, when set and tested in the laboratory, were found to correspond throughout their range with a standard mercurial barometer, showed variations in their readings when transported a few hours' distance from London at sea-level. These results, together with others of similar nature, point to the conclusion that motion, if not the chief, is a very important factor in the causation of index-errors, whatever may be found to be the effect of diminished pressure on instruments of recent construction. An extensive series of readings of the three aneroids last mentioned, compared with simultaneous hypsometric readings at various altitudes from sea-level to well over 21,000 feet, made since the above was written, to be published later, tend to confirm the conclusions stated.

Aneroid readings were taken morning and evening, and oftener when in camp or when climbing, but these were used for the calculation of altitudes only in a few cases at exposed points, where the hypsometer could not be employed. Their chief service was to determine coming changes of weather, and for this purpose they proved a valuable addition to our observations. In this field index-errors were of no account as the indices rose and fell coincidently.

THE END.
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