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Indo-Malayan connection; similarly its Palæarctic connection is vitiated by its Oriental relationship.

On the other hand it is characterized by numerous endemic mammals, such as the takin (*Budorcas*), panda (*Ailurus*), Chimarrogale, *Blarinella*, *Ochotona* (mouse-hare), etc.; by many of the pheasant tribe, such as the tragopans, monauls, and blood pheasants; and by many genera of plants such as the Ranunculaceous genera *Kingdonia* and *Beesia*; *Omphalogramma* (*Primulaceæ*); *Sporoxeia* (*Melastomaceæ*); *Leptocodon*; and others. Whether future research will assign any orders of animals and plants exclusively or almost exclusively to this proposed region remains to be seen.

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### MOUNT EVEREST EXPEDITION

RECENT letters and telegrams received from the Expedition show that it has been possible to carry out very nearly to date the programme for the start of the Expedition from Darjeeling, in spite of unforeseen delays in the delivery of the stores, and still more unexpected breakdown in the transport train of mules lent by the Government of India. A few minutes before the beginning of the Anniversary Dinner the President received a telegram from the Chief of the Expedition saying that they had entered Tibet all well and sending hearty greetings to the Society.

But the confident expectation in which those at home were following in imagination the progress of the Expedition day by day was sadly interrupted by the distressing news that Dr. Kellas had died at Kampa Dzong on June 5 of sudden heart failure. His death at the outset of the Expedition is a serious loss to the party, for he possessed in a remarkable degree the power of mountain travel coupled with enthusiasm for the scientific investigations of the physiological effect of high altitudes, together with a talent for training coolies in Alpine work which had alone made it possible for him to carry out in the years before the war several noteworthy expeditions in the Himalaya. When in February last he accepted the Committee's offer of a place on the Mount Everest Expedition, he at once began enthusiastic preparations. At the beginning of April with four Sherpas he made the first ascent of the fine peak of Narsingh (19,130 feet), and during the last fortnight of the month made a sustained attack on Kabru, reaching what he describes in his last letter as the comparatively easy snow below the final peaks at about 21,000 feet whence he was compelled to return for lack of time. He reached Darjeeling only on the evening of May 10, to start on the 10th with the Expedition. Dr. Kellas had seemed to be an exception to the rule that men above fifty cannot stand the strain of prolonged exertion at high altitudes,

and many friends were confident that in spite of his age he would go as high as any one this year on Mount Everest. But it must be feared that he fell a victim to his enthusiasm, and that he did not allow himself the necessary rest and good feeding between the strenuous journeys he had been making almost without pause since his attempt on Kamet last autumn.

The preparation of the Expedition had been considerably hindered by the very late arrival of the S.S. *Hatarana*, by which the bulk of the stores had been dispatched in the middle of March. On May 10 Colonel Howard-Bury wrote that the vessel had been lying in Calcutta for a fortnight, but owing to the congestion in shipping she had been unable to get a berth or to land anything. When, however, soon after this date the ship was at last berthed, the stores were with the willing assistance of the Indian railways very quickly delivered at Darjeeling.

A letter from Mr. Mallory, who sailed with the scientific equipment and the balance of the stores by the S.S. *Sardinia* on April 8, showed that this ship had also been considerably delayed, and he said that it might be necessary to land at Madras and proceed by railway, instead of going on to Calcutta. What happened in this respect is not yet clear, but he and his forty odd cases of "personal luggage" seem to have arrived in time at Darjeeling.

Mr. Raeburn reached Darjeeling soon after the middle of April, and had been able to collect a good number of Sherpa coolies, several of whom came from a village just south-west of Mount Everest, and had been north of the mountain as far as Tingri. A letter from Colonel Howard-Bury dated May 18 said that that morning he had dispatched the first part of the expedition with fifty mules and attendants, seventeen high-level coolies (all Sherpas), two Lepcha coolies, two cooks, and an orderly. The remaining fifty mules and twenty-two coolies were to start on the following day. He had been unable to obtain for his clerk any hillman with a knowledge of shorthand or typing, but hoped to have as interpreter a nobleman of Sikkim who would meet the Expedition at Kalimpong.

The Expedition considered itself fortunate in obtaining a loan from the Government of India of 100 mules selected from the depôts at Sialkot, Amritsar, and Meerut. So long ago as February 28 the Quartermaster-General in India had given instructions for the selection of the best obtainable in each of these depôts, sturdy small-sized mules, suitable for mountain travel, and fully trained for pack-work. Staff-Serjeant J. R. K. Taylor, Supply and Transport Corps, was to be in charge, and the personnel included a troop duffadar, three naicks, thirty-nine lance-naicks and drivers, two saddlers, one blacksmith with a knowledge of carpentry, one shoeing-smith, a cook, a bhisti, and a sweeper. Precise instructions were given for the selection of the best and most reliable personnel and animals, and General Officers Commanding-in-Chief were



asked to depute their inspectors of Supply and Transport to satisfy themselves personally that the best possible selection had been made.

It was natural therefore to feel that the transport was as near perfection as could be, and that in this respect the Expedition would have an enormous advantage over any previous Himalayan expedition. The transport mules arrived in good time at Darjeeling, and were described as a fine-looking lot—plump and sleek. It was therefore with much surprise and great disappointment that the committee learned from the Chief of the Expedition that the transport had broken down badly only a few days out from Darjeeling. The mules proved soft and quite unaccustomed to work in the hills. By the end of five days they were hardly in a condition to carry their own line-gear, and it became necessary to hire local animals to replace them. A letter from Colonel Howard-Bury, dated "Sedonchen, May 23," seems to imply that he might find it necessary to rely entirely on local mules and ponies accustomed to the Chumbi route.

This unexpected breakdown must have been very embarrassing to the Expedition, and has caused some anxiety to the committee. When in the course of correspondence it became clear that the Expedition would have to bear a considerable cost arising out of the loan—for field allowances, for outfit, for separation allowances, etc., there was always the consolation that at any rate the transport would be above reproach and the principal anxiety of the Expedition removed. Even when the committee learned that they would have to hire a hundred mules to lend to the Government of India to replace those lent to the Expedition, it was still possible to think with satisfaction how much superior Government mules must be to those hired to replace them. But when we learn that still another hundred mules must be hired to replace the broken-down transport in the Tista valley, it becomes a matter for humorous consideration how much the loan of Government transport will eventually cost the Expedition.

It was of course inevitable that the great difficulty would be in the start, in the rainy season, in the horrible climate of the Tista valley: once over the Jelap La in the Chumbi valley the conditions improve very rapidly. The telegrams which have been published in the *Times* on June 14 and 15 dated respectively from Sedonchen and Phari showed that in spite of all troubles of transport and weather the party were in good spirits and making excellent progress. They had planned to be at Kampa Dzong on June 1, travelling in two divisions, and we know that the second division must have reached that place within two or three days of the scheduled time, because of the sad news from Kampa Dzong on the 5th. From Kampa Dzong to Tingri is unknown country, but reported easy going. There is every reason to hope that the reconnoissance of the mountain approaches will have been well in hand before the end of June.

## MOUNT EVEREST EXPEDITION

AS the expedition gets further away from the telegraph at Phari the news of it comes necessarily at longer intervals, and at the date of writing, July 20, we have no more recent information than that published in the *Times* of Wednesday, July 13, dated from Tingri Dzong on June 23. This does not, in fact, cover the journey later than about June 14, but it begins to tell us something of the new country in which the expedition was moving from the time they had left Kampa Dzong. It will be remembered that in the *Journal* for January we published a picture taken by Mr. Claude White while the Tibet Mission was encamped at Kampa Dzong in 1903. It shows the country towards Mount Everest as open and rolling. This is the great plain over which the expedition marched 16 miles to Lingga: a name which is at present not on our maps. The second night's halt was at the fort of Tinki, and we learn from Colonel Howard-Bury's telegram that there were in the neighbourhood several prosperous villages with large monasteries, and that the Jongpen had been very hospitable. The Tinki pass proved to be quite easy, and the expedition descended into the valley of the Yaru, the principal affluent of the Arun, and pitched camp at Chusher Nango, which name also is unknown to the Indian map. At this point the expedition forded the Yaru, and continued on its southern bank to the confluence with the Arun. Here the topography of the telegram becomes a little vague, but it appears they forded the Yaru again and advanced along the north bank of the Arun, having to cross a rather dangerous quicksand, which was an unexpected impediment. It had always been a question what was the nature of the Arun's crossing on the way to Tingri, and how far towards its source the expedition would have to go before the river could be forded. On this point the telegram is silent, but since near the junction the Yaru is reported as 80 yards wide and about  $3\frac{1}{2}$  feet deep, it seems probable that the main stream, though probably larger, is of this section and somewhat of the same proportions, and that, at any rate, it does not flow in a deep gorge as it does further south, where it passes between Mount Everest and Makalu.

The question upon which we hoped to have early information was the nature of the country south of the Arun, and whether the expedition could turn towards Mount Everest without going all the way to Tingri. On this there is at present no report, and it is not clear whether the expedition went to Tingri because the Arun was not fordable, or because the country to the south seemed to offer little promise of a convenient approach to Mount Everest without going further west.

Following on the death of Dr. Kellas, the expedition has suffered a further loss, that we hope is only temporary, by the illness of Mr. Raeburn, the leader of the mountain party, who was unable to throw off the ill effect of the mountain diarrhoea, which had affected several members of

the party, as is very common, and who was sent down to recuperate at the Moravian Mission Station at Lachen, near the head of the Tista Valley. A letter from Dr. Wollaston announces his safe arrival with Mr. Raeburn at Lachen, and his intention to return immediately to catch up the expedition, leaving Mr. Raeburn in the hands of the nursing sisters at the mission. Dr. Wollaston's letter fully confirms the conclusion already expressed that Dr. Kellas seriously overtaxed his strength in his attack on Kabru last April. He had returned to Darjeeling most exhausted, and having lost a stone in weight, only nine days before the expedition was due to leave. He succeeded however, by his pluck and his resolute dislike of being doctored, in persuading his colleagues that there was really nothing the matter with him, and he died a victim to his enthusiasm, for it is clear after the event that he was really unfit even to leave Darjeeling.

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## REVIEWS

### EUROPE

**A Human Geography of the British Isles.**— L. B. Cundall. London: Nelson & Sons. 1920. Pp. 359. 5s. *net*.

APPARENTLY this is meant to be a text-book of geography. The writer does not state his aims in writing it, and the title is a very imperfect clue to the contents—a considerable proportion of which can by no stretching of terms be classed as either "Human Geography" or as directly relevant to a geography of the British Isles. The actual statements are often open to question, as *e.g.* that on p. 245, "Hampshire is a broad alluvial plain . . ." One can only wonder why the book was written at all. C. B. F.

**Ordnance Survey Maps: Their Meaning and Use.**— M. I. Newbigin, Edinburgh: W. & A. K. Johnston. Pp. 128. 1920. 2s. *net*.

This is the second edition of a very useful aid to the study of the British Ordnance Maps. Every one who has occasion to use these maps and wishes to get the most out of them will do well to read this little book carefully. It is full of valuable suggestions. C. B. F.

**Aftermath.**— M. I. Newbigin, D.Sc. Edinburgh: W. & A. K. Johnston. 1920. Pp. 128. *Price 5s. net and 3s. 6d.*

Of all the various contributions to Political Geography during the last half-dozen years the most valuable have come from Miss Newbigin's pen; and she has done well to remodel some of them in this book. It is a study of the Peace Terms in direct relation to the geographical factors, and is based on a serious analysis of the principles underlying the five Treaties.

The result is a vivid, if only outlined, picture—illustrated by fifteen maps—of the Europe which has emerged from the Treaties, and to the eastern half of which the twentieth century is already bringing the same industrialization as was brought to the western half by the nineteenth century. This means a further decrease of food-growing in Europe, and an increased dependence on areas which were once deemed too hot or too arid to be of value to Europeans. That is to say, one fundamental impulse, which drove Germany

down into hell ! That an English lady should have been able to endure these extreme hardships, and to have shown so much tact and perseverance in overcoming not only physical difficulties, but also those human obstacles which are generally the greatest impediment in the way of travelling, is a matter of particular congratulation. And we who have listened to her this evening must not only congratulate Mrs. Forbes upon her great pluck, energy, and spirit, and the long foresight with which she planned out this remarkable journey, but also upon the admirable manner in which she has described her journey to us. On all these accounts I know you will wish me to convey to Mrs. Forbes an especially hearty vote of thanks for the extremely interesting paper which she has given to us.

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### TRAVELS IN TURKISTAN 1918-20

Captain L. V. S. Blacker, Q.V.O. Corps of Guides,  
Punjab F.F.

*Read at the Meeting of the Society, 2 May 1921. Map following p. 248.*

#### Part I. A Mission to Kashgar.

A WORD of explanation will be needed to account to you for the presence of His Majesty's troops in Central Asia. That takes us back to the autumn of 1917, when Falkenhayn's "Yilderim" army wavered in his hands, and the German higher command saw that the Byzantium-Baghdad-Basra line, and its goal at Bombay, were for ever out of their grasp. The cry of "Pan-Islam," too, had made no impression on the loyal ears of Punjabi, Maroccan, or Lesghian, and the fertile brains of the C.U.P. were instructed to find a new one. Though checked in the deserts, in Arabia, Iraq, and Iran, yet a certain success had crowned enemy efforts to spread the taint of treason in Moscow, and their thoughts turned to Turan and to the steppes.

Islam had spurned the Prussian, so his vapid psychology took him back to Attila, his forbear, and to the monstrous iniquities of Tamerlane and Ghengiz Khan. His strategists pondered over Batum, Baku, and Bukhara; his secret agents spoke in the caravanserais of the spacious days before Mahomed brought a civilization, while Afghan cities filled with Osmanli drill-sergeants and Magyar gun-layers.

The Red Terror, nourished by German trade agencies, had laid hold of Tashkent and spread over all the Russian dominion in Turkistan, where 180,000 Germans, Austrians, and Magyars had been confined in their prison camps. Amongst these were the men that had been the garrison of Przemyśl. In October 1917 all were "comrades," so of course there could be no prisoners, and the kindly Soviet opened the gates in the barbed wire and discontinued the ration issue. Ninety thousand ex-prisoners of war died during that winter. Many of the survivors joined the Red Army, some fled to Afghanistan, and some worked for, or starved with, the easy-going Kirghiz and Sarts.

All this the German turned to account. In Afghanistan he formed the "Imperial and Royal East Indian Detachment"; in Turkistan, missions, under various cloaks, organized the surviving prisoners into battalions and brigades, gave them good new uniforms and boots, and tried to smuggle trained specialists to Afghanistan. In 1918 Turkish troops had penetrated into the Caucasus, and a German Army Corps was earmarked for Baku, which indeed it reached. It could from Baku be railed to within five days' march of Herat, or to within twelve days of Kabul. The hordes of the steppes, so hoped Enver, who now imagined himself a second Hulaku Khan, would pour at his bidding to the passes of the Hindu Kush, and then German, Turk, Austrian, Afghan, and Tatar together into the fertile plains of the Sutlej and the Ganges.

It was a fine dream, and a prosaic modern touch was lent by the three years' cotton crop of Ferghana and Sir Daria, many thousands of tons, that the enemy desired to transport into Germany to be made into propellants, either through Baku or else by way of Orenburg and Moscow. This vast store of cotton now lay rotting in the warehouses of Turkistan, or served as bullet-proof protection on Bolshevik armoured trains.

In early 1918 all these matters were hidden from us, or only discerned dimly across the great spaces of deserts and ice-bound mountain ranges, over which even the hardy Central Asian trader now seldom came. Information was essential, so three missions of widely different size were dispatched. From Baghdad General Dunsterville set out on his venture to the Caspian that he has so well described. Through Baluchistan and up across the 700 miles of East Persian desert went Sir Wilfred Malleon's Mission; whilst our own party, the smallest of all, trudged up in March and April 1918, over the northern passes of Kashmir, through Gilgit and Hunza, to come under Sir George Macartney in Kashgar, in Chinese Turkistan.

The Mission comprised three British officers, not including Sir George himself, whom we were to meet at Kashgar, and sixteen soldiers, of whom all but two belonged to the "Q.V.O." Corps of Guides; the two were riflemen of the Royal Garhwal Rifles. It was most appropriate that the Guides should have furnished nearly all the soldiers of the mission. As long ago as 1873 a troop of the Guides Cavalry and a platoon of the Guides' Mounted Infantry had crossed the 18,000-foot Karakoram Pass, and penetrated with Sir Douglas Forsyth to Yarkand and Kashgar, then ruled by Yakub Khan, the Atalik Ghazi, who had expelled the Chinese and annihilated their garrisons. This little force traversed all Eastern Turkistan, even making its way into the then unknown region that is now called Semirechia and into the Tian-Shan.

Our little band packed themselves into a few lorries at Rawalpindi, and in two days reached Srinagar. We crossed the great Wular lake in boats, and the real journey began. It was now April and the country was all under snow, and in these conditions the Tragbal and Burzil passes

were not too easy to cross, even at midnight. We were fortunate not to encounter any avalanches, and sixteen days' chilly marching took us to hospitable Gilgit. Our baggage required no less than 180 porters, who consequently had to move in three separate columns, a day's march apart.

In Hunza we met with a real full-blooded welcome from His Highness the Mir and all his hearty lieges. We crossed the Mintaka Pass on to the Chinese Pamirs accompanied by a Hunza escort, with whom our Regulars had established very friendly relations. At Tashkurghan we met some of the 6th Orenburg Cossacks, who were holding that post on their own account, carefully ignored by the Bolsheviks.

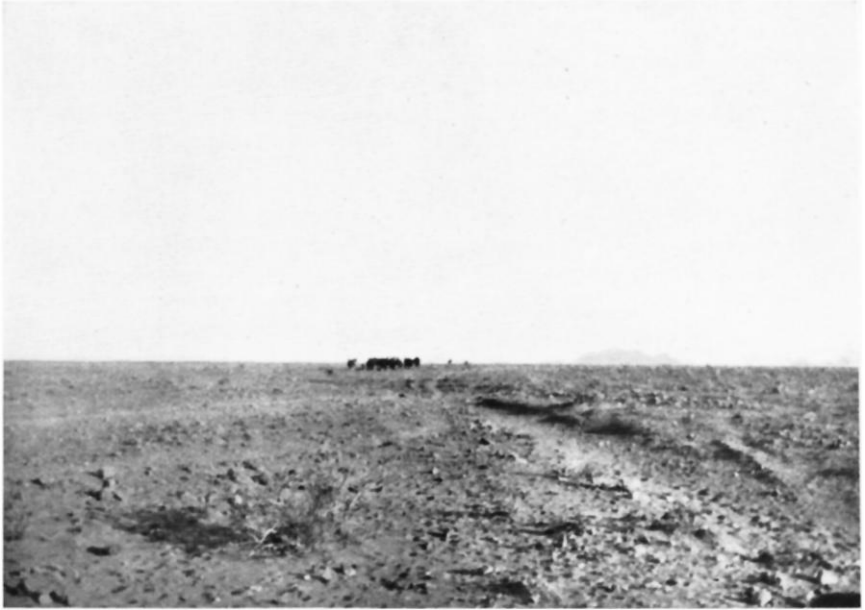
These Orenburg Cossacks are a fine hardy lot of men, and we had met before in 1914. My regiment has been stationed for nearly eighty years in the most northerly cantonment of the Frontier Province, and the 5th and 6th Orenburg Regiments have for many years been just opposite across the frontier, only a few ranges of hills away. Consequently the regiments have 'seen a good deal of each other in the past, in remote valleys of Central Asia. On this occasion we were allies, and the fact was celebrated with junketings.

Next day over in the Chinese fort we dined also with the Chinese Amban, who holds both military and civil charge of the Chinese Pamirs, and then pushed on towards Yangi Hissar and Kashgar over the passes of Kök Moinak, Kizil Dawan, and Kara Dawan.

We had employed yak transport from the south side of the Mintaka instead of porters, and now all hands were mounted on the little shaggy Kirghiz ponies. This track is that usually taken when the Gez defile is blocked by floods. It is in many places very rough, and the passage of the Tangitar gorge is no easy matter. For miles one fords the torrent every few minutes and clambers over rough boulders. At last after several days we came out into the wide valley of Chong Kurghan that opens on to the plain of Turkistan and the Takla Makan desert.

In due course we reached Kashgar by way of Yangi Hissar, meeting with a sumptuous reception from the Chinese authorities at each place. Our host at Yangi Hissar was a Chinese Mahomedan Colonel, Ma-Tung-Ling. He made us at home in his yamen, hung with texts from the Koran painted in the Chinese fashion in curiously Chineseified Arabic characters in black on red paper and silk scrolls. Phlegmatic as the Chinese are, their officers could not refrain from commenting on the bearing and turn-out of our detachment and on the handling of their arms.

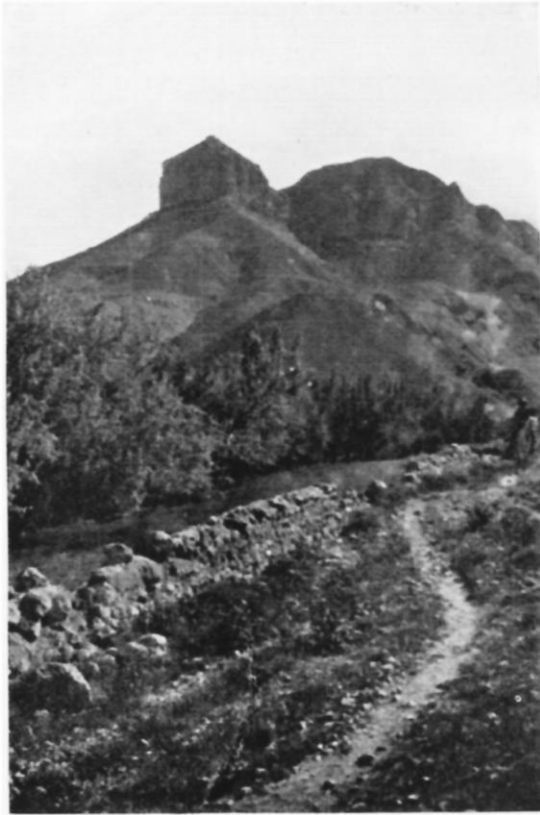
It soon became clear to us even in Kashgar that the Tashkent Bolshevik Soviet was a power in the land. The first revolution had passed off almost bloodlessly, but a reaction set in. The Orenburg Cossacks, under Ataman Dutov, had achieved much success against the Red Army in 1918 in the steppes north of Tashkent, and in March, as far as I can remember, they attacked the city, aided by the cadets of the Military College. They soon defeated the Bolsheviks, but some evil



THE EAST PERSIAN DESERT



MARKET AT BAIRAM ALI: RUINS OF OLD MERV IN DISTANCE



HILL OF PANJ MAND ON THE TRACK FROM  
MESHED TO KELAT-I-NADIRI



INTERIOR OF KELAT-I-NADIRI ON MISTY DAY, LOOKING NORTH TOWARDS  
DARBAND-I-NAFT. JA-I-GUMBAZ IN MIDDLE DISTANCE



genius prompted them to put themselves under the command of a lawyer. Hence the Soviet very soon turned the tables on them, and they lost the city, though they retained a hold of the Orenburg Railway that connects Moscow with Tashkent. This circumstance was of no little value to the Allies, since it prevented the Turkistan cotton crop from being sent to Germany by that route. In fact, the operations of this loyalist army of Orenburg Cossacks form a fine chapter in the story of the war, and one that has not come into the limelight. For three years this force of Ataman Dutov's, averaging some seven thousand strong, often without ammunition, fighting with swords and lances, held its own against the Red forces all round them. They were quite isolated from Allied help, and in fact from any other loyal force, except for the brief period when they were in touch with the army of Admiral Kolchak, himself a Cossack.

Meanwhile the Musalman of Tashkent, Kokand, and Bukhara revolted against the Soviet. In all three cities the rising was suppressed with great slaughter. Kokand was razed to the ground by high explosive shell-fire, and thirty thousand souls were reported massacred: it had been one of the greatest commercial cities of Asia. In Bukhara one Kolesov used armoured cars in the crowded streets, which ran with blood. Although the Reds gained control over the city, to this day they have little or no hold over the country districts, where large bands of Uzbeks and Kipchaks roam the valleys, maintaining a guerilla warfare against any Bolshevik force that leaves the railway and the guns of its armoured trains.

In June three British officers of the Mission, under Sir George Macartney, left Kashgar for Tashkent. A motor bicycle, brought up from India packed in six loads, was used here for the first time, from Kashgar up to the Kizil Dawan in the Tian-Shan. We spent practically three months in Russian territory, and Sir George has himself described the episode in the *Central Asian Journal* of June 1920.

In Turkistan five wars were being waged against the Bolsheviks: by the Orenburg Cossacks on the north; by the Semirechensk Cossacks in the east; by several thousand Uzbeks under Irgash Bai and Mahomed Amin Beg in Ferghana to the south-east; by the Turkman under Oraz Sardar in the south; and by the Ural Cossacks on the Sea of Aral.

To crown all, during the week in which we arrived in Tashkent, three companies of the XIXth Punjabis joined the Mensheviks coming from the south-west and made our situation still more hopelessly involved. The Soviet were worried and showed a tendency to hold us responsible for their troubles, especially in the matter of the XIXth Punjabis of General Malleeson's force. However, we had a more or less plausible explanation for everything.

The Mission, under Sir George, returned towards Kashgar when its work in Tashkent was completed, crossing the frontier into China in the end of September. We did not touch Kashgar, but eluding certain

Bolshevik efforts at Andijan, Osh, and Gulcha, travelled on to the Pamir over the Terek Dawan, now under snow, and thence by a goat track over the hills to K k Su and into Chinese territory at Irkeshtam.

At Irkeshtam we found a number of loyal Russians in the Customs post on the Russian side of the frontier, and two Bolsheviks in the telegraph office up the hillside. We outnumbered them and had no trouble. From here we took a little-known track leading down the Kizil Su valley on to Opal and Tashmalik, and were able to make a few topographical notes and to write a description of the route.

At Tashkurghan exciting news awaited us. A gang of two hundred Germans, Turks, and Afghans had been seen by a merchant crossing over from the Great Pamir north-eastwards towards Yarkand.

This news was for us the forerunner of seven weeks' desperate marching over unexplored snow-bound ranges in the kit we stood up in, and, at times, on the shortest of short commons. In view of the reported strength of the enemy we called in the detachment of the 6th Orenburg Cossacks at the post to help us, and with our force made up to some fifteen rifles, pushed along at dusk down the wild gorge of the Tashkurghan river where it plunges down from "high Pamere" to the great plains. It was a night-mare march, for up to three in the morning the men and ponies were clambering along the face of cliffs that would have been difficult in broad daylight. Some extraordinarily good luck favoured us, and we made the wretched hovels of Shindi without any broken bones. There was no trace of our party here, and the gorge lower down to the north-east is impassable for man or beast, so after five hours' sleep we pushed south-eastwards up a pleasant valley to Wacha, where there are one or two hamlets and some grazing-grounds of the Aryan Sarikolis. A track goes from here to Sherbus, lower down on the Tashkurghan river, but it is so dizzy that even the Pamir Tajiks have to be led over it blindfolded by the local people.

At night we all rendezvoused at Wacha, having found no trail, and had a good and much-needed feed off a fat Pamir sheep seethed in a great pot, into which every one dipped his fingers. Next day we crossed the Sarikol range by an unmapped pass near peak 18,550 and struck the Taghdumbash valley again. We left the Cossacks watching the Mariong Pamir in case anything might turn up. At Dafdar we struck fresh news. Fifteen mounted armed men had come over from the Russian side, across the Sari Kuram pass, had passed through the hamlet at midnight, and a lonely shepherd had seen their tracks in the untrodden snow of Ili Su. We pushed on up the desolate Oprang, collecting seven rifles of the Hunza Company of Scouts from Payik, and (thanks to Sir George's efforts) an indispensable pony-load of flour, which was to be our sustenance for a long time to come.

Up in the Oprang we plunged into the blue. Snow was falling and the ponies' feet made no sound. Ahead of us lay the hugest mountain rampart in the world.

After dark we came to a couple of small ragged yurts in the gorge of the Ili Su, and found two Kirghiz damsels who made us welcome and confirmed the news of the party we were after. Next morning snow was still falling, and we, bipeds and quadrupeds, had a tough scramble over ice-sheets and cliff faces to the top of this pass of Ili Su. Sven Hedin, as he describes in his book 'Through Asia' (vol. 1, p. 686), tried to cross it, but turned back. On the crest, about 17,000 feet, the sun came out and our eyes were gladdened by unmistakable tracks in the snow of the north slope. We hurried on down, finding more tracks, and bivouacked in the snow under a cliff and some boulders. All next day we struggled down this abominable steep and rocky valley, having latterly to push through close-knit thickets. We came also upon a broken tea-bowl marked "Made in Japan." The fracture was new, and it was too good to have belonged to some wandering shepherd; it must have come from Afghanistan.

Sometimes one or two Tajiks come down to a spot here called Issik Bulak, where is a hut and some traces of ploughing. We found a couple of yaks here that were most useful as mounts. Then dropping out of the snow we bivouacked alongside roaring brushwood fires in a glade called Baital Jilga, where we found a new empty cartridge case. We had now got to know the tracks pretty well from gazing at them some fourteen hours a day, and could identify the various horses that the enemy rode from their hoof prints. Next day was memorable, for we came down on to the mighty Raskam itself. For a short time we were racked with uncertainty. Were the tracks going to lead up the valley to the east, whither we would have to pursue for hundreds of miles through the desolate wastes of the Raskam and the unexplored Kara Kash towards Khotan, and to Lop Nor and possibly even to Shanghai?

It was known that von Hentig, a justly celebrated German emissary, had a year before made a similar journey from Badakshan, and we reckoned ourselves to be on the track of some one of the same kidney. The trail led down to the water's edge, and we just managed to cross the swift river. It was a touch-and-go business, and only the standing luck of the British Army saved several drownings, or, what would have been just as bad, the loss of some rifles. We had become so hardened to cold after weeks of the wintry Pamir that the stripping off of our clothes to struggle through the Raskam seemed like a pleasant sun bath, though the month was November and the altitude 10,000 feet. The trail led slanting up the great stark slope of the mighty Kuen-lun, and when we panted for breath at the summit of the Tupa Dawan a most wonderful view unfolded itself. To the south the mighty snow-peaks of Muztagh, Oprang, and Hunza; to the east the desolate Karakoram; to the north ridge upon stark ridge unrecognizable from the vague map; to the west we looked down into the untrodden gorge of the mysterious Raskam, flowing between sheer cliffs towering 7000 feet from the water's edge.

From here we plunged down a break-neck shaly slope into the

Quotchkor ravine, where we baked some of our dwindling flour into flapjacks on flat slabs of stone. Two hours on through dense thickets at the bottom of a narrow V-shaped cleft to our great surprise we came upon Fatima, a loquacious Kirghiz woman with a little old silent husband; they probably belonged to some hamlet down the Raskam valley. She told us that our pursuers were now only five days ahead of us, and this was confirmed by the distinctly fresher tracks. She even sold us a little barley-meal after some wheedling, and this helped the food supply. As we did not know where we were going, or how far the nearest cultivation was, or how many days' rations the enemy had, it was most welcome. Lower down the hills by which we were shut in seemed to get lower, and it seemed that we were only a few days' march from the plains of Turkistan. We learnt better afterwards.

Suddenly the trail ended. Casts forward were fruitless, both hillsides were unclimbable, so we went through the thick jungle in the valley bottom with fixed bayonets. We found nothing; suddenly the regular dafadar came upon the narrow mouth of a side ravine so filled with scrub that it had appeared to be unbroken hillside. Up this funnel the tracks led, and we followed, with all precautions against an ambush. We climbed and climbed up a small steep valley, and towards the upland was a small trickle of a spring where we had to bivouac for the sake of the exhausted animals. An early start into deepening snow took us up to a lung-racking pass of some 17,500 feet, called Furzanak, whence we continued the taking of bearings that we had commenced on the Tupa Dawan.

The descent led apparently nowhere into a maze of rock-bound ravines, but at noon we came to a tiny patch of grass. The enemy had spent the night here and reshod some of his ponies. A dead tame quail and his pathetic little straw cage told us the nationality of at least some of the party. Then a desperate climb of 4000 slippery feet found us at the summit of another snow-bound pass, grimly named Yettim Qozi ("the pass of the last lamb"). The struggling moon lit our way down to a bleak open upland, a "hanging valley" swept by a bitter wind. No water, no fuel, and no grass, so supperless to bed we went in holes scraped in the snow. This was the worst bivouac of the lot, and next day the wretched nags were too weak to be ridden an inch; however, they carried each man's blanket and our tiny stock of flour. The next pass called the Kandek was easy to ascend, but had a most breakneck descent to a tiny patch of grass near by a spring. We made our one and only meal here. This single meal had become a routine: we had neither time nor food for more. At the Raskam a fortunate shot had secured us a young burhel, which we had roasted whole over a brushwood fire and devoured, tearing it with our hands. This gave us a stomachful of meat, and the recollection of it lasted for several days. The food situation was now critical, and I had to watch the men to see that they did not give me more than my share.

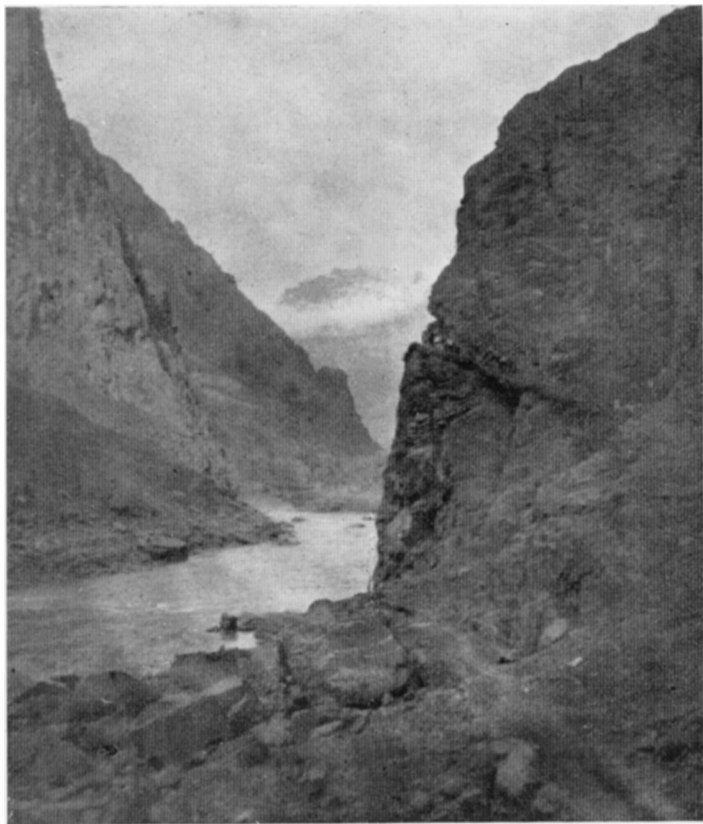
Captain Blacker's Route from Chinese Pamir to Yarkand.  
October, 1918.

THE GEOGRAPHICAL JOURNAL, SEPT. 1921



Published by the Royal Geographical Society.

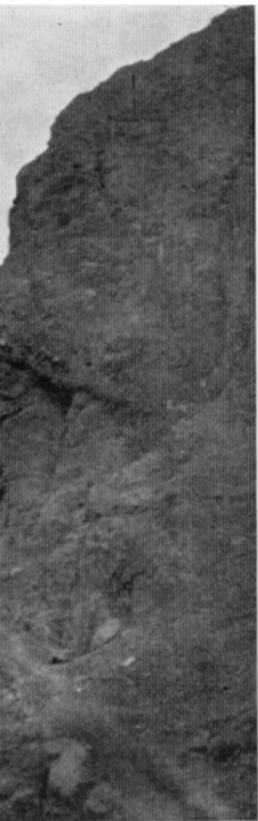
CHINESE PAMIR-YARKAND  
Blacker.



THE UPPER VALLEY OF THE OXUS



RUSSIAN FORT OF I



THE OXUS



RUSSIAN FORT OF PAMIRSKI (MURGHABI)

The next pass was called Pilipert, and we crossed it in the afternoon of the same day. It was one of the most difficult of over a hundred high passes that I have crossed. There was a snow cornice on the summit, a desperate matter for the ponies, of whom two died on the descent into the valley, where we found the cold remains of a fire and the round trace where a yurt had been, and this seemed to bring us back into the world of men.

Next morning we crossed the worst of the lot, the Payik pass with a cornice on the summit and ice-sheets on the slopes, so bad that unriden as they were two more ponies died on the way down to Kulan Aghil. The effects of the cold, exposure, and hunger began to show themselves on the men, and they suffered from old wounds picked up in France, Africa, and Persia. But not a word of complaint was there; the growing freshness of the trail was a constant source of joy to all ranks, and they were eager to push on. We had crossed six difficult passes in four days' climbing and descending about 54,000 feet. We had thus covered 16 map miles in over sixty hours' marching. Deasy describes how it took him ten days to cover 12 miles in this region.

We dropped into a valley full of vegetation, and the prospect was brighter. The map seemed less nebulous, and I knew that this Kulan Aghil valley had been traversed before by a European. Deasy calls this valley Kulan Urgi. A few miles down was a hamlet of five huts called Poenak, and we were once again amongst human beings, including at least one fair and apple-cheeked damsel with a kind heart for a soldier. We obtained some more ponies here, some barley and a sheep, and having, after many days, dined, fate could not harm us.

Now to our surprise the trail did not lead straight to Yarkand over the Sandal pass, but turned to the east up the valley of Chup. This is blank on the map, but actually holds some tiny homesteads every few miles and a little cultivation. We rounded up some more ponies, leaving our worn-out steeds behind, and at five in the evening reached a village high up in the valley, where we got some information from the Yuzbashi of the Kirghiz. Pushing on at dusk, by midnight we reached the summit of a desolate pass, a weirdly beautiful scene. To the south and east were the ice-bound peaks of the Karakoram and Kuenlun, virgin snow fields and glaciers as far as the eye could reach, the smallest details showing up clearly in the bright beams of the moon. Ahead of us to the north was a labyrinth of deep and gloomy gorges, equally unknown and untrodden, in black shadow. We were again in snow, but a steep path took us down through loess dust to a spring, forming the headwaters of the unmapped Shaksu.

At three in the morning we staggered in to a hamlet called Bulun, not on the map. The aborigines were astonished at seeing two batches of strangers in forty-eight hours, and they all talked at once at the tops of their voices. We were only two days behind the pursued, but here we got



off the trail, confused as it was by the villagers' yaks and goats. It was too late to turn back when we found the error. So we hoped to hit the tracks again later and pushed on. During all that day and night we made a nightmare march. We had to toil over four great passes, led up to by endless winding gorges. Of the first two I never found the names, as we met no human being, but the third and fourth are called Sakrigu and Akkas, and we crossed them in a soundless darkness. There was no track north from the Sakrigu; the animals floundered and struggled amidst huge boulders, and the scene was so ghostly that we could scarcely believe ourselves on this planet.

The cliff sides, a few yards apart, towered sheer up for thousands of feet, and at one turn a titanic excrescence of rock showed up like a perfectly formed ace of spades. This we took for a good omen, and when we debouched at midnight from the dreadful canyon to the desolate valley of the Kalisthan the men were still cheery, although there was no grass, fuel, or shelter. We pushed on over a fourth pass, and almost unconscious with fatigue came to the wretched deserted hamlet of Jibrail at four in the morning.

In this one march we had crossed four passes averaging about 14,000 feet, the last two in the dark. I estimate that we had covered something like 30,000 feet of ascent and descent in that time. Towards the latter part of the march we were too numbed to take much count of our surroundings, though this whole region, including the Chup, Shaksu, Pokhpu, and Kalisthan valleys, is almost unknown. Bogdanovich, however, made a journey into part of it in the nineties of the last century. Chup is a broad spacious valley, with plenty of vegetation. The lower part is rough and stony; the upper part is walled in by rounded turf-covered hills of loess, in which tracks are worn down into strange narrow runnels of 3 or 4 feet deep. Night marching here is a most creepy proceeding, since men and animals move silently in the deep dust, and the whole countryside is shrouded in an unearthly stillness as one toils up along the brink of some misty chasm.

On the north side, in the Bulun valley and in the next valley on, we found rougher and steeper hillsides covered with pine trees, which seem very rare in all the ranges east of the Tian Shan; at any rate, there are none to be seen in the Kara Kash valley further east by the Karakoram, nor yet in the valleys further west till one gets to Bostan Terek.

The Shaksu and Pokhpu country is wild in the extreme. Till we crossed the Kalisthan we were in a labyrinth of immensely deep canyons, with vertical sides, barren of vegetation except a little scrubby grass that covered the tops of the passes.

In Pokhpu there are one or two huts and tiny patches of barley tilled by people called Taghliks. The whole population of the area, however, did not seem to be more than half a dozen.

On the Akkas pass we found loess again.

At Jibrail there was no water, so we slept for a very few hours in a hut and then pushed on. Just as we were riding off down the valley a very old pink-faced Kirghiz, with a couple of horsemen, evidently a man of some consequence, and from his green turban apparently a Haji, came round the corner, much surprised to meet an armed party, and somewhat overwhelmed by the uncompromising aspect of the ragged and hirsute men. His attempt to cross-question us was anticipated by our demands for an explanation of his presence and doings, and eventually we took him along with us. He became most friendly and helpful, in time.

Since coming down from the Kara Tash during the night we had had no water, and we were very glad to find a kind woman in a hut in the Ak Masjid valley who gave us some out of a gourd about midday. We were now in a broad open sandy valley, bounded by low hills, which took us to Kök Yar (often called Kugiar on maps). The country was very dry, and this was the only drink we got till we reached that village. Here we really got back to the world and truly realized the meaning of the word "Vitamine," as only men can who have been for weeks on nothing but meal and meat, with precious little of the latter. We filled up on corn-cobs and melons and felt years younger.

Only five hours could be spared for eating and sleeping, since we realized that the pursued were probably in the Tiznaf valley, the next one parallel to ours to the west. I sent into Karghalik, making certain unostentatious arrangements there, and at midnight, mounting our horses again, we carried out a compass march over the low range of hills that separated the two valleys. Careful steering aided by luck brought us straight down into Arpat Bulun village, after an exhausting march through the fine deep sand which covers all these foothills. We found no clue in this village, and so pushed on straight across the desert to Khan Langar, which we reached about midday next day. Our track took us clear of the foothills, and now and again we came to little patches amidst the sand irrigated artificially by water led down from the hills. This march was extremely trying, since we had had no proper sleep since we left Poenak four days before, and we had a continuous fight to keep awake whilst marching.

Khan Langar is a big village on one of the countless branches that the Yarkand river is split up into. It is on the edge of the big fertile oasis. We pushed on to Posgam, reaching it at about three in the morning, after a lot of trouble in the dark amongst the irrigation ditches and canals.

Next morning found us in the Chini Bagh a mile outside Yarkand city. One of the men was sent inside with orders to bring out the Aksakal (consular trade agent) without attracting attention, and in this way we got on to the trail of our pursued again. Before the teeming population was properly awake we cantered through the narrow alleys, and suddenly the inhabitants of the Badakshan Sarai received the surprise

of their lives when nearly a score of distinctly tough-looking Punjabis, Pathans, Hazaras, and Kanjutis, bursting in on them with their bayonets fixed, made them put up their hands. The sorting out of the fifteen that we wanted and the securing of their Austrian rifles and bayonets took some little time and care, but we got all but two, who with some more rifles were arrested by the Chinese later on. To our great disappointment there was no German with them.

The next two days were spent in ceremonial interchanges of visits with the Chinese Mandarin.

Having captured our prisoners, our next object was to rejoin our battalions in Palestine and Mesopotamia as quickly as possible. We covered the 155 miles to Kashgar in two and a half days, and as the season was late much of this was done by night.

We spent a few days in Kashgar, handing over our prisoners to the Chinese authorities and collecting fresh ponies and rations for the journey to India. The month was November, and the crossing of the Pamirs and all the great ranges to the south of us did not seem a very pleasant prospect, especially as we had no tents and no more kit than we stood up in. Every day made the outlook worse, so we pushed off to Tashmalik on November 5, Guy Fawkes' day, with rumours of Boche peace talk in our ears. We reached the Chinese fort at Bulunkul on the snowy evening of the third day, and found ourselves in the grip of a Pamir winter. At Payik, on the sixth day out, we found the broad swift Karachukor river frozen 2 to 3 feet thick, and many Kirghiz lying dead from influenza. This was at an altitude of 14,000 feet, and no Kirghiz would have been there at all in that season had not Bolshevik depredations driven them from the lower valleys of the Alai.

We were very glad to get over the Mintaka, and the night's bivouac at Mirkushi, in an open sheep pen, at 13,000 feet seemed almost stuffy after the howling blast of the Pamir. I had managed to provide the detachment with sheepskin caps at Kashgar, and to wrap the stirrups in felt, which undoubtedly helped to ensure our immunity from frostbite; all the same the cold was something never to be forgotten. My men were old and tough campaigners, some of whom had been bandits in civil life, and they needed no dry-nursing in the matter of their fingers, toes, and ears. Every man of the party but two contracted influenza, but nevertheless kept up with the patrol, which averaged over 40 miles a day; in fact, it was essential to keep moving if we hoped to reach lower levels without catastrophe.

At Gircha we got in touch again with our good Hunza friends and slept on beds under roofs, wonderful and almost forgotten luxuries. At Gulmit, falling in with His Highness the Mir, we played the very intensive polo of the country and watched dances. Two days more found us in Gilgit, on the twelfth day out from Kashgar, which I think was pretty good going for winter. We had to leave our ponies here, and pushed on



GAU KOTAL IN KARA DAGH, NEAR KHAUR VILLAGE, BETWEEN MESHED AND TEJEND, LOOKING NORTH-WEST



TYPICAL HILL COUNTRY IN SOUTH-EAST CASPIAN REGION



PASS BETWEEN BAJGIRAN AND JIRISTAN IN THE KURD COUNTRY OF  
NORTHERN KHURASAN



DURBADAM VILLAGE NEAR KUCHAN, NORTHERN KHURASAN

on foot over the Burzil and Tragbal passes into Kashmir and all the luxuries of civilization.

## Part II. To Trans-Caspia.

The men had only had a few days' leave in their homes when the second phase of our wanderings opened, and we were sent up through eastern Persia to the Merv front. Railhead was then at Mirjawa, arid and sunbaked even in December, and we marched up across the dreadful dreary wastes of Persia for some 800 miles. After plodding along for about 300 of these we got into higher ground and more northerly latitudes and found ourselves in winter once again. In fact, for a good many days we marched through deep snow, having to our joy exchanged our camels for a wagon at Birjand. Snow fell frequently, but it was child's play compared to the Pamirs, even if some of the quaint black hospital and commissariat followers from Madras, Bombay, and Hindustan found it a little too bracing.

We arrived at Meshed in January, and after a few days there pushed on through the snowbound Kara Dagh into the Trans-Caspian province of Turkistan, the home of the Turkman, till now a tribe of almost legendary fame.

We reached Merv by train and found our force headquarters installed in the late Tsar's palace at Bairam Ali, an eastern suburb of the town. Merv just before the war had been quite a flourishing city of western American appearance and seemingly of mushroom growth. Really, of course, it is one of the oldest cities in the world. Many great ruins cover the oasis; one former Merv was built by Alexander, and half a dozen others by great conquerors: Greek, Mongol, Arab, Tatar, and Persian.

Our force was a curious and motley assemblage. The Commander-in-chief was General Sir Oraz Sardar, K.C.M.G., a Tekke Turkman, and the son of their chieftain Tagma Sardar who was killed in 1884 defending Geok Tapa against Skobelef. Our general, then a youth, was sent to the Imperial Corps of Pages at Petrograd, and finally became a Major-General in the Imperial Army. Under him, the British portion of the force was commanded by Brigadier-General Beatty, and comprised one section of two 18-pounder guns of No. 44 Battery R.F.A., two or three squadrons of the 28th Light Cavalry, and the 1st Battalion of the 19th Punjab Infantry. Besides this there were two or three batteries of Russian guns and howitzers, manned by Menshevik officers and N.C.O.'s; a squadron of Russian Cavalry, similarly composed, and a couple of regiments of Turkman horse and a battalion of foot. The Bolsheviks, some seven thousand strong, had been very roughly handled by this little force, which had only just grown to its present size. At the actions of Artik, Kaakha, and Dushakh the Red Army, which included some five thousand trained regular Magyar and Austrian soldiers, had been routed by less than three companies of the Punjabis, who with a squadron or two

of cavalry bore the brunt of the fighting. Even the guns did not arrive till later.

These little battles, away in the remote deserts of Central Asia, had no little effect on the duration of the great war itself. They were fought, it must be remembered, when General Dunsterville's two British battalions had been forced out of Baku, and hence nothing but these few hundred Punjabi bayonets stood up against the German plan of uniting a German Corps from the Caucasus with probable Afghan armies, with thirty or forty Austrian battalions from Turkistan, with the Red Army, and with Enver's hoped-for insanitary hordes. Nor was this end reached without severe fighting: at Dushakh alone Major Knollys' tiny force lost 50 per cent. of its effectives, including every officer. Nevertheless the Bolsheviks were chased 300 miles in four months.

These three battles were fought whilst we were still in Tashkent, and in almost daily intercourse with the Soviet and their War Ministry. This fact of being on the wrong side of our own front was of great interest to us, and the panic that the commissars got into at the news of each fresh defeat caused us vast if carefully suppressed merriment. Before long the very mention of the word "sipahi" made them shiver with apprehension. In February another action took place; the Red Army sustained a fourth reverse, but as, for reasons of high policy, they were not to be pursued to the Oxus, stationary warfare ensued through February and March. During this breathing space some of the detachment were occupied in getting into touch with our Turkman allies and compiling information about them, largely ethnological. Meanwhile the Turkman regiments were in an unsatisfactory state, lacking discipline and cohesion almost entirely and technical training to a very great extent. So the balance of my N.C.O.'s were put on to instruct them, with most encouraging results. Karaz Sardar's regiment was perhaps the best of the three. He was a very fine old man and very typical of his race. He and some of his sons were killed later in a Bolshevik ambush near the Persian border.

These Turkman are of course the same that one reads of in Morier's "Haji Baba of Ispahan" and celebrated for their wonderful raids into Persia. O'Donovan, who was with them in 1885, gives an excellent picture of their life in his 'Merv Oasis.' They are a hospitable, frank, upstanding and engaging race, and were very friendly to us, especially to the Punjabis, with whom they have much in common. They are not unwarlike, but one doubts whether they could ever stand against Afghans, Pathans, or Punjabis, however well led or trained.

The fact that they are nomads is much against their ever becoming real soldiers, since they have not that attachment to the soil that agricultural peoples have, which leads them to get killed in defence of it. All the same, whatever their shortcomings we came to like them a great deal.

The Russians had done much to develop the country in the few years before the war. At Bairam Ali, for instance, a canal had been brought

down from the barrage at Hindu Kush, whose water came from the hills near Kushkinski Post, the fortress over against Herat. This canal irrigated many square miles just east of Merv, and these were considered a private estate of the Tsar Nikolas; hence his palace there. Many of the plots had been given to Hazaras, descendants of Jenghiz Khan's troops. Some of these Hazaras, who were of course Russian subjects and tenants of the Tsar, were serving in the Guides Cavalry, following their fathers and grand-fathers, and four of them were now in my detachment, so that the fortunes of war had brought them many score of marches back to their own homes. At the end of March we were relieved by a large force of General Denikin's Volunteer Army, and we marched back into Khurasan, charged with the defence of that province against the Bolsheviks.

One of our commander's first steps was to visit the Emperor Nadir's marvellous natural rock fortress. I accompanied him, with a small patrol of Guides. The Khan, Fatteh-ul-Mulk, a Turkish gentleman, entertained us most hospitably, and we spent a full week inside this marvellous place, where millions of pounds' worth of Nadir's treasure is reputed to be buried. We did not find it. The Kelat is something over 12 miles long, with a maximum breadth of about 5, and girded all round with vertical and inaccessible cliffs. Only three or four gorges allow passage to camels, and there are some goat tracks affording entrance besides. The district with some outlying parishes is held as a Karaul or fief from the Shah of Persia by the Khan, who is the chieftain of a tribe of Turks settled in this place by Shah Abbas, I believe. They live in half a dozen villages inside, growing crops and fruit and keeping numbers of cattle and sheep.

The weather during our stay in the Kelat was very wet; in fact, both my journeys through this part of the Kara Dagh were in surroundings quite unlike the shining East. Slippery clayey mud underfoot, leaden skies overhead, and a constant soaking drizzle in the valleys gave way to snow flurries on the uplands. It was certainly homelike, rather too homelike, but it accentuated our appreciation of the warm billets that we generally found, and of the steaming tea and cheery samovar that my young orderly always managed to conjure up.

The first day was fine, and our climb to Khist hill, one of the peaks of the northern range, was amply repaid. Four thousand feet almost directly below us little puffs of smoke showed where Bolshevik and Loyalist were locked, with their armoured trains, in a not very deadly conflict. We could scarcely have had a better view of the fight from an aeroplane. Northwards from there the inconceivably immense plains of Mid-Asia stretched away to the Arctic Ocean. To the west we could discern Artik, and to the east Dushakh, both on the railway, and the scenes of British battles. Before the rain came we secured a few photographs and made a hasty sketch of the interior.



The sudden outbreak of the Afghan war brought us back swiftly to Meshed, which was to some extent threatened by the Herat Division of the Afghan Army. Several of the detachment under my command were at once employed on the Afghan frontier, and in the intervals of their other duties managed to carry out some topographical work, not to mention securing some excellent little horses from the King's Own Regiment of the enemy's cavalry. Old frontier soldiers will appreciate how early one must rise in the morning to obtain anything from an Afghan regiment unbeknownst.

During June we were able to visit Nishapur, the home of Omar Khayyam, and to map some of the route. Besides this we managed to put in a good deal of topographical work during the summer, mainly with improvised appliances. But in August we had the good fortune to be able to map, mainly with a plane-table, some 700 square miles of quite unexplored and not uninteresting country, which took about twelve days. The party, which was very small, comprising only six officers, N.C.O.'s, and men, furnishing its own escort, moved north from Meshed, crossing into the beautiful well-watered Khaur valley by the aptly named Sanduq Shikan pass. Next day we crossed the main precipitous range of the Kara Dagh by the Gau Kotal, dropping down breakneck gorges into the tree-embowered village of Zao.

Then cool upland country gave way to arid sun-baked downs which in springtime afford grazing to the flocks of Kurd, Hazara, and Turkman. We touched human habitations at the wretched little frontier village of Chacha, meeting a few Tekke Turkman, who favoured us with their unexpurgated opinion of the Bolsheviks. For the next three days we marched up and down over countless small barren ridges covered with a curious alluvial blue clay. The whole country shelved gently down north-eastwards from the vertical scarps of the Kara Dagh range towards the plains of Merv and Tejend. Strangely enough though, at the very foot of the gentle alluvial slopes a vertical cliff wall suddenly springs up to over 500 feet in height and many score miles in length. In fact, this wonderful barrier stretches along the Russo-Persian frontier line from Sarakhs right round to Gifan in the Kurd country. Kelat-i-Nadiri is itself what a sapper would call a "horn-work" to this rampart. Here, as in most stretches, the vertical cliffs face inwards towards Persia, the outer slopes being gentle and quite rideable. Not only is this cliff line unbroken except where occasional streams force their way through narrow gorges, but it is quite impassable for anything but trained cragsmen with ropes. Moreover, it is in most places a double line, the main scarps of the mountains being supplemented by an outer wall of much less height but greater impenetrability.

No doubt the unwarlike if convivial Persian owes his continued existence in no little degree to this natural bulwark, which has kept the Turkman and the Mongol and even the Russian from getting at him as effectually as they would like.

Crossing the caravan track joining Meshed to Sarakhs and Merv we came to two interesting landmarks. The first is a little artificial lake called K l-bibi, "the lake of the lady." The lady is the same that built Pul-i-khatun, the daughter-in-law of Tamerlane. The lake is formed by a dam across the mouth of a little glen, and fed by a spring hidden among rushes at its eastern corner. The lake water is salt, doubtless as a result of the desiccation of this part of Asia, but the spring is fresh and was very welcome, since we had drunk nothing but brackish water for several days and scanty at that. A few miles on, hidden in the folds of the undulating but desolate countryside, is the ruin of a fine fort called Robot-i-Sharaf. Its walls are of red brick of a surpassingly good quality, its gateways adorned with antique blue tiles, and its corner towers are of an unusual shape, semicircular with little clean-cut salients joining them to the curtain-wall on either hand. A dry well and reservoir 100 yards away showed whence water had been obtained in the spacious days of Tamerlane and his dynasty, and certainly this barrier-fort must have been a strong and shapely pile in its prime.

We struck back to the south by the Mazduran pass over the Kara Dagh range into the Kashaf Rud valley, and three days' more marching up this poisonous affluent of the Styx found us back in Meshed. The results of a week's drinking of a nasty solution of Epsom salts and mud locally known as water demanded a few days' recuperation in that city.

During this journey, and subsequently, I had the great advantage of the presence of Subadar Afraz Gul, a young survey officer who has worked for years under Sir Aurel Stein in Central Asia. There are few countries therein that he has not visited, and his topographical skill and knowledge are of a very high order indeed. In fact, for rapid plane-table work in an unknown countryside, I have never seen his equal. A sequel to this piece of topography was the discovery that the latitude of the Russian maps about Sarakhs is incorrect to the extent of 3 miles. This error diminishes towards the Caspian, being some two-thirds of a mile in the longitude of Ashkabad (Poltaratsk).

But we were not left idle for very long. In August, several hundreds of the Armenian rabble in their ranks having turned traitor, the Volunteer Army lost Ashkabad to the Reds, who threatened to invade Persia, or at least, by means of propaganda, to incite the scum of the slums to give trouble. The Persian frontier had to be watched, not only to give due warning to our commander of a regular attack, but also to keep out spies and propagandists. Accordingly, the detachment was moved to a little frontier village named Bajgiran to perform the advanced duties, whilst a company of regular infantry provided the main military force. The detachment had some 160 miles of frontier to watch, and this section was flanked on the right by the territory and levies of the Khan of Darragez, and on the left by the Sardar of Bujnurd and his Kurds.

The work soon split into two sections, the patrolling, or combatant,

and the topographical. The former was helped out by fifty Kurdish levies who were attached, thereby expanding the party to an appreciable fighting unit, whilst the trained surveyor Subadar Afraz Gul, helped by two more jemadars and a couple of N.C.O.'s with some hastily imparted topographical training, devoted themselves to the map work.\* During 1919 and early 1920, in spite of many interruptions from blizzards, deep snow, constant rain, actual fighting, and minor disturbances, they dealt with nearly 14,000 square miles of country, of which an appreciable proportion was up till then not only unsurveyed but unexplored. The details of this work would fill an article by themselves, but it may be of interest to show how such a large area was covered by an average of only two to three topographers in the time.

The essence of the matter was mobility. The topographers, assistants, cooks, and escort were all mounted and armed. As the country was unsettled, each party had to include six rifles, and four or five of these were usually Kurdish levies in our pay, armed and clothed by us. They were most useful as interpreters, messengers, and especially as foragers for the party, which of course lived on the country, except for tea and sugar. The surveyor's assistant who carried the plane-table, and his cook, were fortunately both Punjabis, so could ride and carry carbines. Hence there were no unarmed mouths to be provided for. The *modus operandi* was this. The operator set up his table and made his first fixings from two or three peaks near Meshed which had been fixed by the Afghan boundary commission in 1885. The regular survey section that was employed on the line of communications very kindly went out of their way to fix a few more peaks in the Hazar Masjid range for us. From these the plane-table could be set up with a very fair accuracy, and well enough to fix peaks many miles further afield as points to hang more plane-tabling on.

The plane-table itself was not used for the whole area, of which nearly all was covered by work on cavalry sketching-boards; where there were Russian maps already of an area, the sketching-board was the only tool used for filling in detail. In short we used the plane-table where the regular survey section uses the theodolite, and we used the cavalry board where they would use the plane-table. The accuracy thus obtained was amply sufficient for needs of the fighting troops, since there was nothing remotely approaching static warfare and the consequent squaring of maps for the artillery. In this way most of the valleys were traversed by a mounted N.C.O. with a "cavalry board," at the rate of some five miles an hour. The result of this work was then adjusted by means of the pantagraph to the net made by the plane-table, sometimes with the aid of a pocket sextant. Important heights were obtained clinometrically on the plane-table, but less important ones by aneroid. We were careful, however, not to rely upon the latter instrument except for relative differences.

\* As an instance of the natural aptitude of the Pathan for topography, one young Yasafzai was able to make a useful plane-table sketch after ten days' instruction.

Each topographer carried a hypsometer, which he boiled at his night's bivouac. Calculation in correcting boiling-points for air temperature was avoided by employing a graph drawn on squared paper, whereon the ordinates are altitudes, the abscissæ are degrees and tenths, and whereon several lines are provided, of different colours, at convenient differences of air temperature. The hypsometer height thus corrected was plotted on squared paper again, using the back of Army Form C 2121. On this the ordinates are again altitudes and the abscissæ times, *i.e.* days and hours. The topographer not only plotted his hypsometric heights on this, but also his barometric readings, being careful to read and plot his aneroid whenever he boiled his hypsometer. The resulting curve made it extremely easy to correct the aneroid heights by inspection and a pair of dividers. A little work was done by traversing in narrow valleys on the subtense method, using a pocket sextant and a lance. This instrument was of use in places to replace a theodolite, and is certainly excellent for rapid work where great portability is important.

To reproduce the maps required for the immediate use of the troops we used ferrotype paper in a home-made printing frame. The results were not as satisfactory as we should have liked, since the paper is too fragile for much use in the field, especially as we had to employ the kind giving chocolate lines on a white ground, to admit of roads, etc., being coloured in by hand. This was the best we could do, and we were fortunate enough to be able to prepare and print maps of the area in which fighting soon after occurred in time for issue to troop and company commanders concerned.

Meanwhile the patrolling portion of the detachment, even expanded by our fifty Kurds, had its hands full. Very soon after the capture of Ashkabad, now renamed Poltaratsk, the Bolshevik "Politicheski Oddiel" commenced to send propagandists and agents across the frontier to work amongst the Persian and Caucasian bazaar loafers. Our patrols caught several of these, and before long the Red administration could get no one to take on the job. An interesting poster that we secured, specially designed for Indian consumption, depicted three naked emaciated Dravidians harnessed into a plough, at the tail of which stood a typical John Bull with projecting teeth and ginger whiskers, brandishing an automatic pistol in one hand and a nagaïka in the other.

The winter was characterized by incessant patrolling, which helped us to correct the maps to some extent, and by an influx of refugees and deserters from the Red Army. We entertained a wonderful medley, the bulk being Magyars late of the Austrian Army. Besides many sorts of soldiers—Czech, Austrian, Rumanian, Serb, Italian, Cossack, Lesghian, Turkman, Kurd, Tatar, Armenian, Georgian, Persian, Pole, and Russian—we had many civilian refugees, including women and children. Often in the depths of winter these wretched people arrived, starving and frost-bitten, led by smugglers over mountain goat-tracks. Perhaps our most

remarkable guests were seven Algerian soldiers, still in their "bleu horizon," who had been captured by the Reds at Odessa in 1917, and had made their way *via* Moscow to Tashkent and Ashkabad. Wonderful to relate, the first patrol to find them included two Pathans who had served in the Lahore division when it was brought up to Ypres in April 1915 to counter-attack after the Germans had broken the line with gas. There they had lain with a North African division wherein four of our escapers were serving.

During the spring Bolshevik plans began to crystallize. Emboldened by the success of their *protégé* Kuchik Khan, on the Caspian coast, they endeavoured to create a second Kuchik in Khurasan. They selected a minor Kurdish chief named Khuda Verdi Sardar, who had, before the arrival in Khurasan of sepoy and cossack, made a comfortable livelihood by brigandage. He had even collected seventeen wives, some not uncomely. The slump in the bandit business had made him discontented and a ready tool for Comrade Paskutski's hand. Accordingly, the other side despatched several convoys of machine guns, rifles, and ammunition to him. We managed to keep touch with all these, but since it was an internal Persian matter could not interfere, at any rate at first. The Persian was quite unequal to competing with the situation, and matters became critical, several hundred Kurds, with good ponies and magazine rifles, joining the standard of revolt.

Open rebellion followed, complicated very much as far as we were concerned by the massing of several thousand Red troops,\* with guns and aircraft, 30 miles to our front on the metalled road forming the main line of advance into Persia. This tied our company of infantry down to the outpost line to watch them, whilst the alarums and excursions went on in the Kurd valleys to the west of our headquarters.

Our three standing patrols in this direction managed, after some adventures, to concentrate at a village called Jiristan, 22 miles to the west, and to which a bridle path ran up a rough narrow valley with cliffs on either hand, over a pass of 7400 feet. Jiristan was at once reinforced by two troops of our Kurdish levies and by a company of Persian infantry. Hardly had they arrived than the surrounding hilltops were sangared by the enemy and the place invested. Desultory fighting followed between our piquets and the advanced elements of Khuda Verdi's forces, and one of the Persian infantrymen was slightly wounded, whereupon the whole company were seized with panic and absconded in haste. Meanwhile our own Kurds, kept to it by their Regular instructors, held their ground.

Fortunately, another company of Regular infantry turned up. This eased the situation with regard to the Bolsheviks, and we were able to send out a small column that evening. The commander was an Afridi

\* The legend inscribed over the door of the Bolshevik First Army headquarters in Ashkabad ran, "Our mission is to set the East in flames."

jemadar of the Guides, with a havildar as his staff officer. Two sections of Kurdish levies were his cavalry; he had a Lewis gun with Khattak gunners, a section of bombers, Regulars, some being Pathans and some Hazaras, and the infantry of the column were a platoon of Hazara foot levies.

This column pushed out at ten minutes' notice, and fought and marched for forty hours on end. The back of the revolt was broken, Jiristan relieved, Khuda Verdi became a fugitive, the Bolshevik 1st Army command turned him down and withdrew their own troops from the Persian border.

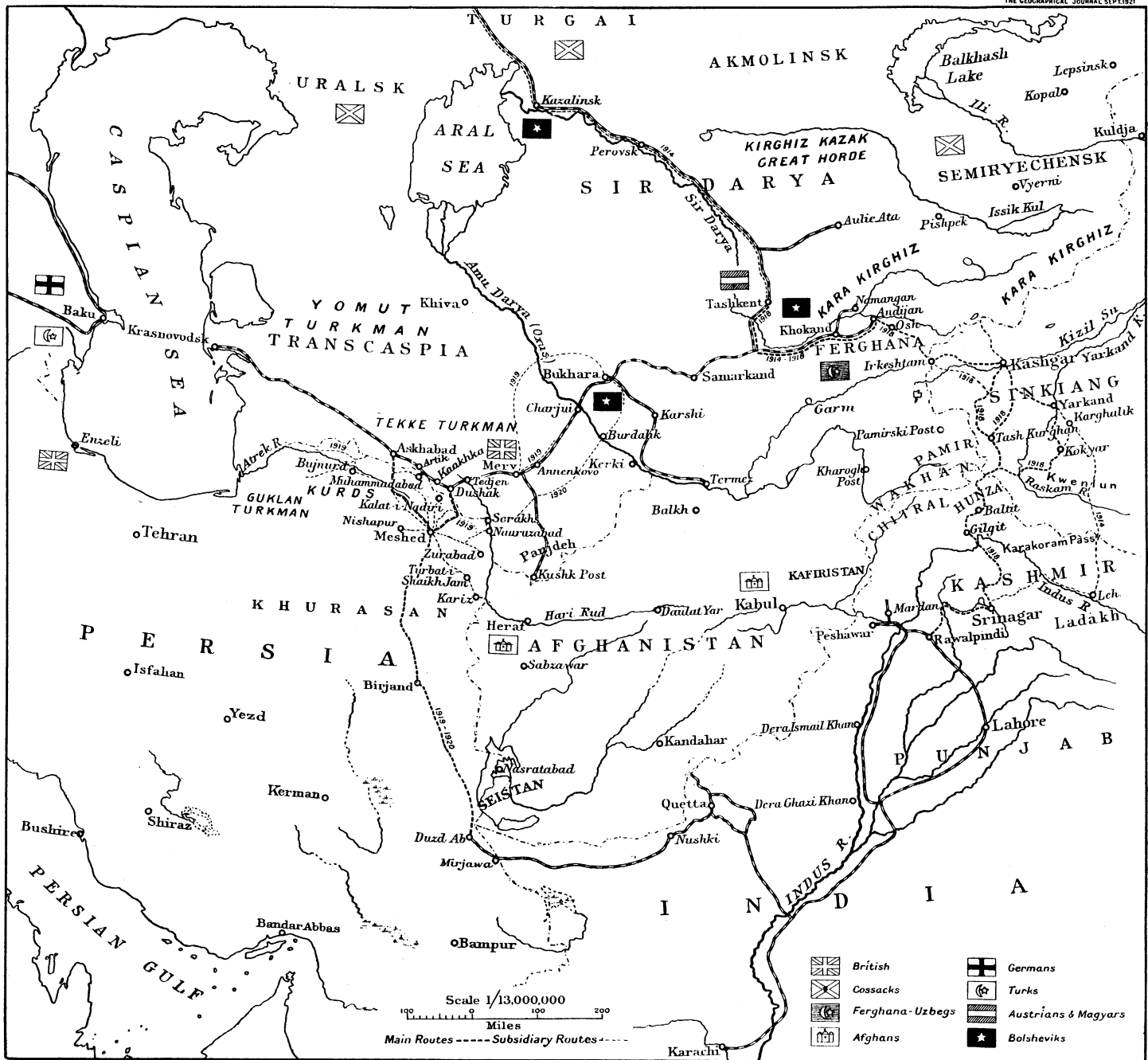
So with a neat exhibition of minor tactics on the part of Jemadar Amal Baz the curtain came down on our three years of toil in Central Asia, and we marched back through 700 miles of hills and deserts to our railhead on the frontiers of Baluchistan.

Before the paper, the PRESIDENT said: Captain Blacker had the advantage of being employed during the war in regions partially or quite unknown. But he had the disadvantage of having to travel so rapidly that he had little opportunity for making and recording observations of geographical interest. We must therefore make allowances for him in listening to the lecture which I now ask him to give us.

*Captain Blacker then read the paper printed above, and a discussion followed.*

Brig.-General Sir PERCY SYKES: I think Captain Blacker must have made a record for distance with his little party, and I should like him to tell us how many thousand miles he has travelled. I imagine it must be something like 10,000 miles, which must surely constitute a record for a patrol, even in the Great War. I noticed that the Afghans he pursued in Chinese Turkistan had the bad taste to go over the most uncomfortable part of the country, and as he was going extremely light, it is marvellous that he got through all right. There is nothing more unpleasant than sleeping without enough bedding, and nothing more dangerous to health. The Sarikol Valley is very interesting. The inhabitants of it talk Persian and are the last people to do so eastwards, and they are, curiously enough, followers of his Highness the Aga Khan. Their leaders go every two or three years over those tremendous passes and make their report to his Highness at Bombay, and it gave me rather an insight into how far the influence of the British Empire stretches. Here was this most God-forsaken place, with winter for ten months of the year, looking steadily to India. When my sister and I went to lunch with the wife of the Russian commandant at Sarikol, she showed us her garden, and there were merely a few little cabbages coming up! It was an extraordinarily cold climate through which Captain Blacker and his party had to travel. It was August when we were there, and I remember on one occasion I woke up to find a couple of feet of snow on the ground. The Pamirs are termed the "Roof of the World," and that is what it means.

I was also deeply interested in hearing about north-east Persia, and I most warmly congratulate Captain Blacker on having added so much to the survey of the country. I used to go about with a solitary surveyor, and managed to do a good deal, but I never had proper resources in the way of men, plane-tables, and theodolites. I think we can see that the war has not been entirely



Scale 1/13,000,000  
 Miles  
 Main Routes ----- Subsidiary Routes - - - - -

- |  |                 |  |                     |
|--|-----------------|--|---------------------|
|  | British         |  | Germans             |
|  | Cossacks        |  | Turks               |
|  | Ferghana-Uzbeks |  | Austrians & Magyars |
|  | Afghans         |  | Bolsheviks          |

Published by the Royal Geographical Society.

Sketch-map showing routes of Captain Blacker's Detachment, 1918-20.

destructive in Persia. Here is an instance of it, both in the shape of roads, to which the lecturer referred, and sound geographical information.

Colonel Sir CHARLES YATE: Our lecturer this evening has taken me back to many old scenes and reminiscences, which, I can assure you, has been a great enjoyment to me. He recalled various scenes in Merv. I recollect visiting Merv very well, and I thoroughly enjoyed seeing his pictures of all the various places round there. I was astonished to hear that Hazaras were amongst the cultivators there. They are a Shiah tribe who live in the heart of Afghanistan, and when I was at Meshed we had a very large influx of them there from Afghanistan. They were known there by the name of Barbaris. When I was Chief Commissioner at Quetta, Sir Claud Jacob, now Chief of the Staff in India, then commanding the Zhob Levy Corps, was able to raise a fine regiment of these Hazaras. A splendid regiment they made, and I believe they did excellent service throughout the war and proved themselves to be capital pioneers and soldiers. I was very glad to hear that some of these Hazaras in the Guides Cavalry had done such really good service with Captain Blacker in his long journey to Merv. It was an eye-opener to me to hear how Hazaras were spreading all round the country from their original home in the heart of Afghanistan, as in my day it was difficult for them to get out of Afghanistan. Captain Blacker also referred to the guns that were taken from the Afghans at the battle of Panjdeh. That brings back long memories of the time when I was at that battle. I was the British officer there at the time, and I remember I had only nine men with me when the Russian troops marched down. The lecturer told us of Kalat-i-Nadiri. I remember visiting the place. It is one of the most curious natural forts you can have—a large semicircular valley rising gradually to the edges with precipitous cliffs all round it. Who is the man who will find out the treasure that is supposed to be buried there? The Persians in my day were very jealous of admitting strangers into the place, but I was able to get there and so was Captain Blacker, though we had no chance of finding that hidden treasure.

The PRESIDENT: In spite of the disadvantages under which he laboured, Captain Blacker has succeeded in bringing us back some valuable information. Most interesting, perhaps, is that part of his lecture which dealt with that very heart of Asia where not only three empires meet but also three great mountain systems meet—where the Hindu Kush and the Pamir Mountains meet the Kuen Lun. Here the lecturer found a succession of terrific gorges and mountain ridges. To set these down with accuracy, prolonged and careful survey would be required, and for that Captain Blacker obviously had no time. But his experiences are valuable as drawing attention to the topographical interest of this region. He spoke also of the loess deposit on the mountains. The atmosphere in Chinese Turkistan is nearly always dull. This is due to its being surcharged with dust from the Gobi desert and the Takla Makan. And this dust is precipitated on to the mountains—the coating being heavier on the outer ridges and lighter the further away from the desert the ridge is. You will, I know, like me to thank Captain Blacker for his graphic description of adventures in widely separated parts, and to congratulate him upon having come safely through them.

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## ON THE ORIGIN OF MOUNTAIN RANGES

Colonel Sir Sidney Burrard, K.C.S.I., F.R.S.

*Read at the Afternoon Meeting of the Society, 9 May 1921.*

THE origin of mountains is a wide topic ; its study requires the co-operation of different students of science, geologists and mathematicians, seismologists and engineers, geographers, physicists and chemists. In a brief paper I can only attempt to refer to a few salient points that require discussion and help.

Mountains are the elevated portions of the Earth's crust, and in these discussions it is necessary to consider at the outset the structure of the Earth itself. The old theory of a liquid interior and of a crust supported by flotation has been abandoned. Modern astronomical, seismological, and mathematical investigations have all combined to show that the Earth is solid throughout and that its crust possesses the rigidity of steel ; the evidence in favour of solidity is now very great, and upon this fundamental fact we ought constantly to insist.

When we come to think out how mountains have arisen, the primary question at issue appears to be this—Have they been elevated by horizontal compression of the surface or by vertical uplift from below ?

One of the most conspicuous features on the flanks of the larger ranges is the compression which strata have undergone : strata which were originally horizontal have been squeezed into folds. It was the compressions of strata that gave rise to the well-known Contraction Theory.

According to this theory the Earth's crust was wrinkled into mountains by horizontal compression ; the Earth's interior was supposed to be cooling and contracting, and the outer crust was thus becoming too large for the shrinking core and was wrinkling into folds. The chief objection to this theory has been that the contraction by cooling is inadequate to account for the amount of elevation which mountains have undergone.\* Osmond Fisher showed that the radial shrinkage of the Earth due to loss of heat had not been sufficient to produce mountains of even 100 feet in height.

Other objections have been raised : it has been pointed out that the principal mountain ranges were elevated in one geological age and that they are confined to certain narrow zones. If a core is slowly shrinking away from its outer shell, the latter will wrinkle in all ages and in all parts of its surface. To ascribe the rock-folds that have been concentrated in Central Asia to a general shrinkage of the Earth's core is tantamount to assuming that the crust is loose from its core.

If moreover ranges were surface folds we should expect to see the horizontal strata, in which the rocks were originally laid down, lifted up

\* Osmond Fisher, "Physics of the Earth's Crust." Dutton, *Phil. Soc. Washington Bull.*, vol. 2, 1889.

and arched over the ranges. The Himalaya ranges are composed of granite, which has been uplifted from below, and although the stratified rocks on the south side of the granite have been compressed, the crumpling which they have suffered seems to be local.\* There do not seem to exist any relics of great arches of strata, such as might be expected, if the ranges were folds of the Earth's crust.

In face of these objections it is difficult to be satisfied with the theory that mountains have arisen from horizontal compression. And we have to face the question—What is the force that has raised mountains? The force of gravity acts vertically downwards; what is the force that is able to lift rock-masses to great heights in opposition to gravity? This force is to be sought for in the physical and chemical changes that rocks undergo. The rocks composing the crust are heterogeneous mixtures, and they are continually undergoing changes. Sir Hubert Hayden told me that the gneiss of the Neilgherri mountains varies in density from 2.67 to 3.03, that is 14 per cent., and that the rock of the Hazaribagh plateau varies from 2.5 to 3.1, or 24 per cent. Dr. Fermor (*Records Geolog. Surv. of India*, vols. 33 and 34) has closely studied the lavas of Western India; he estimates the density of eclogite at 3.3: under a decrease of pressure the eclogite will pass into gabbro of density 3.05 and into basalt of density 2.95. The increase of volume involved in the passage of eclogite into gabbro is 8.2 per cent. An elevation of 2000 feet will be caused by the passage of a column of eclogite, 25,000 feet deep, into gabbro.

As conditions of pressure and temperature vary, rocks undergo changes of volume and density. It is to these changes that we have to attribute the elevations at the Earth's surface. The highest summits are generally composed of granite, and the granite masses are believed to have risen out of the crust.†

The range of mountains known as the Western Ghats skirts the west coast of India, and it traverses two different portions of the crust. South of latitude 16° it crosses an area of gneissic rock, and is itself composed of gneiss, its peaks rising to 6000 feet: north of lat. 16° it crosses an area of volcanic rock, and here the mountains are built up of numerous horizontal strata. It has been thought that the horizontal strata of lava may have been originally laid down at their present high altitudes; but this line of elevation continues beyond the volcanic area into the area of the gneiss; it is evident that there has been a line of upheaval across both areas. The horizontality of the strata and the absence of compression on the volcanic section show that the upheaval has been vertical and that the range has been elevated to 5000 feet without any disturbance or tilt.‡

\* Hayden's sections, plate xxxviii. part iv., "Sketch of the Geography and Geology of the Himalayas." Also sections by Middlemiss, *Mem. Geol. Survey of India*, xxiv.

† "Interior of the Earth," by Chamberlin, *Proc. Americ. Phil. Soc.*, Sept. 1915.

‡ The isolated peak of Guru Sikkar (Mount Abu) standing up out of the desert, 5650 feet high, may be a northern outburst of the Western Ghat range: compare deflections at Deesa and Chaniana with Colaba, *Phil. Trans. Roy. Soc.*, A, vol. 205, p. 310.

The largest protuberance at the Earth's surface is the plateau of Tibet. In 1851 Richard Strachey found the bones of elephant and rhinoceros at a height of 15,000 feet in Tibet, in deposits of silt which are as horizontal now as when they were first laid down (*Journal Geolog. Soc.*, 7, 306).

At its present altitude Tibet is almost arctic in its climate, whilst the elephant and rhinoceros are tropical animals. Strachey explained the presence of these animals in Tibet by assuming that the horizontal strata had been elevated from sea-level to their present height since the time when the animals had lived; he suggested that these strata had been raised vertically without any tilt, compression, or disturbance.

It may be asked if the evidence in favour of vertical uplift be so strong, why has this solution not been accepted? The answer is that vertical uplift does not explain the horizontal compression of strata. In the Western Ghats there is no horizontal compression, but the flanks of the Himalayas and of the Alps furnish evidence of compression. Some writers have tried to divide mountains into two classes, the vertical and the horizontal; but there is no justification for such a step; in one Himalayan area the bones of elephants have been raised vertically, and in another Himalayan area there are signs of horizontal compression.

In this difficulty let me turn to geodesy to consider the evidence it furnishes. Its principal contribution has been the discovery of Isostasy, which has taught us lessons concerning the structure of the crust, and concerning the behaviour of rock masses under varying conditions of pressure. According to the theory of Isostasy, all elevations are compensated by deficiencies of density underneath them, and all oceanic depressions are compensated by excesses of density underneath.

In the diagram (Fig. 1) I have drawn a section of the crust from mountains to sea, and the vertical lines descending from the surface to a depth of 70 miles show the vertical columns of Isostasy. In each of these columns there is the same amount of matter per unit of area: the high columns have no more mass per unit than the low. The high columns are of low density, and the low columns are of high density.

The horizontal lines show how the isostatic crust is divided by geologists into three shells—the sedimentary, the granite, and the basaltic. The basaltic shell is the principal seat of isostatic compensation.

In 1860 Pratt contended that mountains had risen up out of the crust by vertical expansion, and that their extra mass above sea-level was compensated, because its own rise by expansion had created the deficiency below. This explanation is no longer considered complete. Mountains that were elevated many ages ago and that have been suffering losses of rock from the unceasing destruction wrought by weather are found in this our own time to be accurately compensated by deficiencies of matter below. So we have to explain how the compensation of the mountain is being accurately adjusted underneath when its weight is obviously being reduced above by wear and tear.

If a mountain is always being worn away, it must be gradually losing its weight, and if its streams are carrying away its lost material to the nearest basin, the basin must be gaining in weight. Geodesy has proved that the mountain's loss of weight is being corrected by additions underground, and that the gains by the basin are being corrected by withdrawals of matter underground. Mr. Hayford has suggested that there is a subterranean transfer of matter through the crust from below the basin to below the mountain; and he has called this transfer the "undertow." In March last Colonel Tandy read a paper before this Society on "The Circulation of the Earth's Crust," and he gave an explanation of the "undertow." Colonel Tandy expressed the opinion

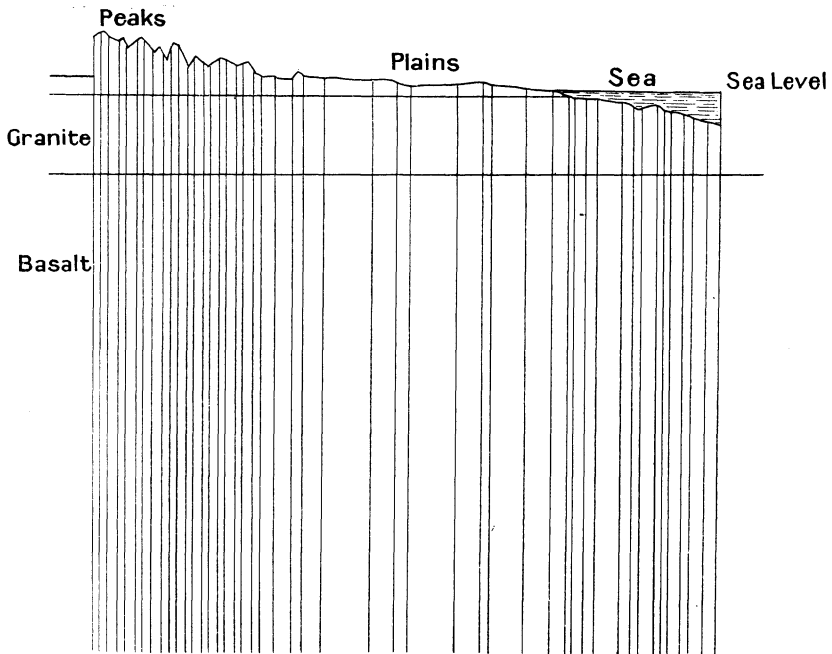


Fig. 1.—Section from mountains to sea.

that the rock-material, eroded from mountain sides, fell down into the valleys, and that it there sank into the crust and flowed back underground to the mountains; by its return flow it raised the mountains in height and restored to them the rock of which they had been denuded above. Colonel Tandy's description of the "undertow" is that of a liquid stream flowing horizontally through the solid crust—from under every valley to under every hill.

Colonel Tandy contends that the falling stones sink by their weight into the crust as though the latter were molten. I have not time in this short paper to review the evidence collected by different branches of science concerning the strength and rigidity of the Earth's crust. But

I may point out that the crust has for ages supported the plateau of Tibet. The isostatic compensation of this plateau does not alter the fact that at sea-level its immense weight is supported by the rocks below it. These rocks show no signs of being crushed, their surface is not yielding. In certain European mines the solid rock has been observed slowly to creep, a phenomenon known as rock-flow ; but rock-flow only occurs when man is interfering with nature. No rock-flow has been detected at the base of the Tibet plateau. In my opinion Colonel Tandy's assumption that stones falling from the Tibet mountains sink by their own weight into the crust is not in keeping with the observed fact that the Tibet mass itself stands without sinking.

Also I cannot follow him when he presses the view that the "undertow" is a stream flowing horizontally through the crust. What is the force that produces a horizontal flow? Gravity acts vertically, and gravity is the force that maintains Isostasy. If the Earth were in a fluid state it would have the form of a spheroid. The strength of rocks is, however, sufficient to maintain mountains at great heights, and thus the figure of the solid Earth is irregular. But gravity is able to correct for these irregularities and to keep the Earth's mean figure the same as it would be if the Earth were liquid ; in other words, the geoid conforms to the spheroid. Under the action of gravity deep-seated rocks change their density ; when a basin is overloaded by silt, gravity decreases the density underneath, and if a mountain becomes too light, gravity corrects the error by increasing the density underneath. If we insist upon the fact that gravity acts vertically, we are forced to the conclusion that a horizontal "undertow" through the crust cannot be justified. Our ignorance of the conditions in the Earth's core debars us from speculating how gravity, acting always in a vertical direction, can balance the horizontal transfers of mass at the surface.

One of the lessons learnt from the researches of Hayford and Bowie is that the rock of the crust is composed of a vast number of vertical columns, some 70 miles in depth, and that these various columns differ from one another in density. The different densities are existing and persisting side by side. The structure of the crust is vertical in character, and its vertical arrangement lends support to the view that mountains have been vertical in their origin.

I have already explained that the chief evidence against this view is the compression of the strata. As I have worked in the area of Himalayan compression for many years, perhaps you will allow me to express the opinions that I have formed.

There have been discovered under the sea several long deep hollows, known as "deeps," very long in proportion to their width. There is one off the coast of Java, another off Japan, and four in the Pacific. There are also similar "deeps" existing on land ; there is a great deep extending along the foot of the Himalayas ; it is in our time filled up with sand and

silt, and its surface forms the plains of India. Professor Suess, the Austrian geologist, was the first writer to suggest that a deep must be related to the range that stands beside it. The Indian deep is bordered by the Himalayas, the Chili deep by the Andes, the Tuscarora deep by the Japanese and the Kurile and the Aleutian islands, which are the peaks of a submerged range.

Suess called these deeps "foredeeps," because he thought that the ranges were moving forward and that the foredeeps were subsidences in front of the advancing earth-waves. Most writers have admitted that there are objections to the old idea of the Earth's crust being wrinkled into folds; Suess not only upholds this idea, but he assumes that his folds are

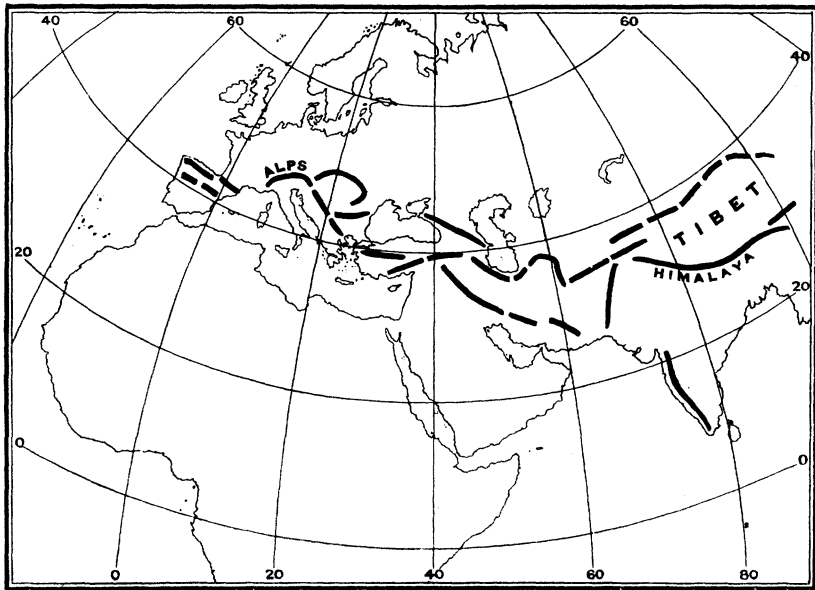


Fig. 2.—Diagram of Alps and Himalaya.

moving across the Earth's surface. He holds that this Indian deep is a subsidence which has left Asia laterally unsupported, and that therefore Asia is slipping southwards.\* But he produces no evidence to upset the accepted view that Asia is firmly supported by the rock foundations underneath it. The weight of Asia acts vertically, not laterally, and Asia does not depend upon any lateral support.

Professor Suess is so widely read that I have to ask you to consider another of his conclusions. This long zone of mountains extends from France to China, and it has been shown by geologists to have been elevated in the Tertiary age. We call its western portion the Alps and its eastern portion the Himalayas because the human race is divided into

\* "Face of the Earth," I, 596, Sollas's translation; also *Geographical Journal*, July 1920, pp. 37, 38, "The African Rift Valleys," by Professor Gregory.

different peoples speaking different languages ; but to the geographer this is one long zone of mountains. Suess contends that Asia has moved southwards because the southern subsidence has removed its lateral support ; but he thinks that Europe has lost its northern support in the Arctic regions and that the loss of this lateral support has caused Africa to move northwards and to fold up the surface in front of it into the Alps. So we have the Himalayas created by the moving of Asia southwards, and the Alps created by the moving of Africa northwards ; and yet these two independent and opposite movements are supposed to have elevated the crust along the same alignment and to have produced one line of mountains. The geological deductions upon which Suess was building are not in accord with the mechanical or the geographical evidence.

The existence of a deep at the foot of the Himalayas has been proved by both geologists and geodesists. There are other submontane regions where geodetic evidence is forthcoming. One's natural expectation is that a plumb-line suspended within sight of mountains will be slightly deflected towards them by their attraction. Isostasy will decrease the amount of the attraction, but will still leave a deflection towards the mountains. At 60 miles, however, from the Himalayas all the plumb-lines are strongly deflected in the opposite direction ; and the only explanation of this curious repulsion is that there exists a hidden deep skirting the hills, and that this deep is filled up with light rock.

In 1871 the Russian Survey reported to the International Geodetic Association as follows (International Geod. Assoc., *Comptes Rendus*, 1871, p. 40) : " At the southern foot of the Caucasus the plumb-line is apparently repelled instead of being attracted."

At Zurich the plumb-line is deflected away from the Alps (*Comptes Rendus*, 1903, p. 408). At Neuchatel it is deflected away from the Jura (*Comptes Rendus*, 1890, p. 161, Annexe B, 11). At Bombay and at Mangalore, 30 miles from the foot of the Western Ghat Range, the plumb-line is repelled from the mountains in a remarkable way.\* My Himalayan experiences have led me to suspect that these repulsions may be due to hidden deeps, and that many mountain ranges may have deeps beside them, which are not visible to the geologist or to the topographer (Fig. 3).

These mountain deeps are now of primary importance ; Hayford's theory of Isostasy has explained all the larger geodetic anomalies except those of one class. This class consists of the peculiar repulsions which have been observed at the foot of mountain ranges.

The error in Clarke's determination of the Figure of the Earth was due mainly to his endeavour to eliminate the seaward deflections at Bombay and at Mangalore.† Recently at the Geophysical Society Dr.

\* ' Board of Scientific Advice, India,' 1914-15, p. 68. " Earth's Axes and Triangulation," by De Graaff Hunter, chap. xi. ; Profess. Paper, " Survey of India," 17, p. 21.

† The Indian arcs of longitude being near the Equator had great influence in the evaluation of the major axis.

Morley Davies pointed to the seaward deflection at Bombay as evidence of the over-compensation of the ocean. So long as these repulsions are unexplained, they form an argument against Isostasy: I do not believe in this argument. I believe that the cause of these deflections is the presence of attenuated rock in the crust, of which no account has yet been taken in the calculations. We allow in the calculations for the light weight of sea-water compared with rock, and we must similarly allow for the presence of abnormally light rock. It is a difficult matter to estimate the depth to which masses of light rock descend into the crust, and for this reason it is essential that we should try and discover what these deeps are.

On both the Atlantic and Pacific coasts of America (lat.  $35^{\circ}$  to  $45^{\circ}$ ) there is a tendency for the plumb-lines to be deflected away from the mountainous regions towards the sea.\* Bowie has attributed these seaward deflections to the light density of the Cainozoic deposits which form the American coast. This explanation is probably correct, but we still want to know what depth of Cainozoic deposit is required to account for the actual deflections.

The American deflections resemble the seaward deflections at Bombay, and there are no light Cainozoic deposits at Bombay. The Bombay coast is composed of the same heavy volcanic rock as the Western Ghat Range: the difference between the coast and the range is that the horizontality of the strata, which is so characteristic of the mountains, has been much disturbed in the submontane zone. At Bombay the geodetic evidence leads me to believe that a deep exists, but it is not a surface feature. Some of the Pacific deeps are 28,000 feet below the level of the sea, and these deeps must be features of the granite shell which underlies the sedimentary rocks. The long deep skirting the Himalayas is completely hidden by sand; its depth cannot be estimated with confidence; from many calculations which I have made I conclude that this deep must descend below the sedimentary rocks into the granite. When I see a deep depression in the solid crust, I can imagine only two probable explanations of its origin; either it has been formed by vertical subsidence, or it has opened horizontally under tension. The elongated forms of the ocean deeps and of the land deeps do not support the view that they have originated by vertical subsidence. When a hollow in the crust takes the form of a long narrow depression with parallel margins it conveys the idea of a fracture; its form is that of a crack. I think that the deeps may have opened under tension.†

Geologists have given proofs that the beds of the Himalayan rivers have been excavated by the streams; no scientific fact has been more clearly established. But I have frequently seen it suggested that in the first instance the main course of a mountain river may have been decided

\* 'Investigations of Gravity and Isostasy,' by William Bowie, 1917.

† "Origin of Himalayan Folding," by Sir T. Holland, *Geol. Mag.*, 10, 167-170. Presidential Address by Sir T. Holland, Section C, Brit. Ass. 1915.



by a fracture in the range. The sections drawn by the Himalayan geologists show that mountains are permeated by fractures; strata are fractured, hill-sides are fractured, boulders are fractured; and water imprisoned behind a range might in the first instance be helped to escape by a rift.

A remarkable feature of the mountains of Asia is that several of the principal river gorges cut across the main ranges at points where the ranges are highest.\* The Sutlej escaping from Tibet makes straight for the peak of Leo Porgial, the highest point of the border range. The Indus rushes for 600 miles across the Tibet plateau before it can escape, and where does it eventually find a gateway? At the very foot of Nanga Parbat, the highest peak of the Western Himalayas. The other great river of southern Tibet is the Brahmaputra, and up to 1914 it was not exactly known where this river had effected its escape. But when its course came to be explored by Bailey and Morshead, it was found to have a passage through the mountains at the very foot of Namcha Barwa, the highest peak of the Eastern Himalayas. I have no time to refer to the other instances of rivers crossing mountains near points of maximum altitude, but I have to say that I think we should be wrong in dismissing these phenomena as mere coincidences. I have been gradually led to believe that these main rivers are crossing the mountains on the lines of ancient fractures. I have had the advantage of discussing fractures with a most able physicist in Mr. De Graaff Hunter, and I think that relief of pressure, generation of heat and elastic rebound are among the probable consequences of crustal fracture (*Proceedings Royal Society, A*, vol. 91, 1915, p. 234). I venture to submit the following explanation of the proximity of a river gorge to a high peak—a fracture occurred relieving the pressure in the crust, the granite expanded upwards and formed a peak, the imprisoned water found a passage through the rift.

If this explanation is regarded as worthy of attention in the case of a mountain gorge, it deserves to be considered in the case of the great deep. What the lesser fracture is to the solitary peak, the main deep is to the range. As the peak arose from a relief of pressure in the crust, so has the range arisen from the opening of the deep.

The lower diagram of Fig. 3 is a section across the Himalayas; the dotted portions show the protrusions of granite; the horizontal compression is shown; the plumb-line is repelled from the mountains; the hidden deep skirts the hills. I cannot draw the deep. The Himalayan geologists place its northern edge near the margin of the hills; geodesists would place it a little further north and inside the hills; seismologists would say that the disastrous earthquakes of Kashmir, Dharmasala, Katmandu, struck the mountains with greatest force within the zone of compression; the geological maps that illustrate the forms of the continents

\* 'Sketch of Geography and Geology of the Himalaya Mountains and Tibet,' 1907, part iii. p. 185.

before the rise of the Himalayas show a long narrow channel of sea crossing Asia along the line of this deep, but the ancient Mesozoic channel embraced both the deep and the range, and it conveys the idea that the present granite ranges may have arisen vertically out of the original deep.

The question still remains—How has this discussion of the Indian deep assisted the problem of the horizontal compression of mountains? In this way: the main Himalayan range runs parallel to the deep; the

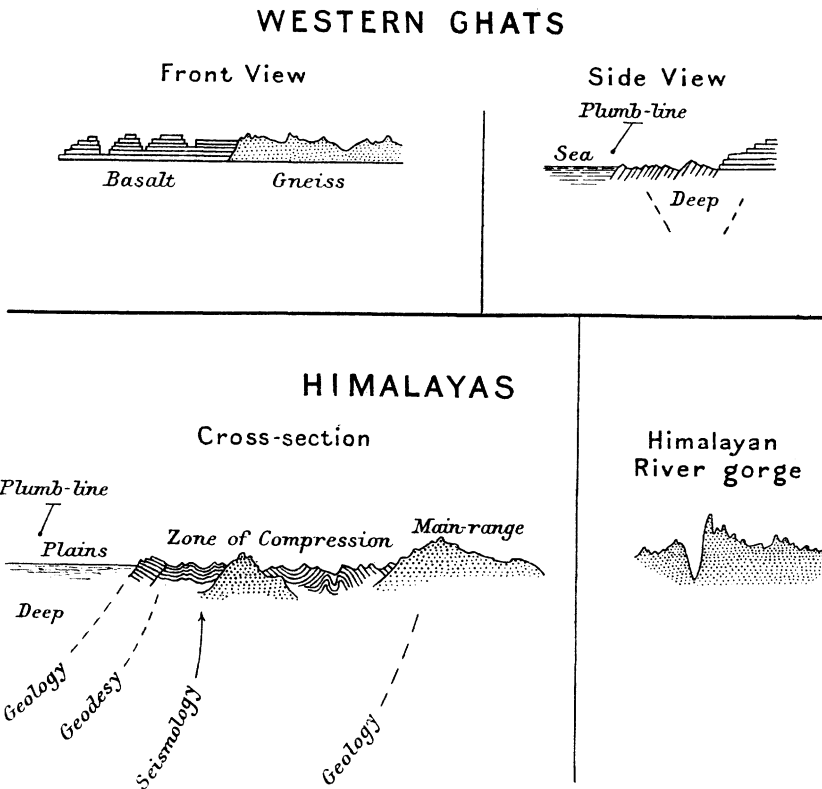


Fig. 3.—Sections showing the "Deeps" of the Western Ghats and the Himalayas.

distance of the main granite outburst from the edge of the deep averages 40 miles; and it is within this zone between the range and the deep that the horizontal compression has been observed. Here we have a zone 40 miles wide, and its surface is one vast rock-ruin: its rocks have been compressed and stretched, depressed and elevated, tilted and cracked: in 19 miles of this zone Middlemiss found a contraction of 8 miles (*Mem. Geolog. Surv. India*, xxiv. 2, p. 77). Is all this rock-ruin due to the shrinkage of the Earth's core away from its outer shell? I have closely analyzed the geological sections by Oldham, Middlemiss,

Hayden, and Vredenburg, and the rock-ruin seems to me to be due to a local cause acting within the zone. The foldings are on so small a scale that I find difficulty in attributing them to a world-wide cause or to Suess's southward advance of the mountains of Asia. It seems to me as if the subterranean rocks in the crust between the deep and the range have been undergoing constant chemical changes. It seems as if the foundations of this zone had been expanding and contracting, and as if their contortions had crumpled the rocks above them. Even within this zone the granite has protruded in many places from below, and the zone itself is one of the principal seismic regions of the Earth.

#### DIAGRAMMATIC SECTIONS ACROSS THE HIMALAYA (AFTER HAYDEN)

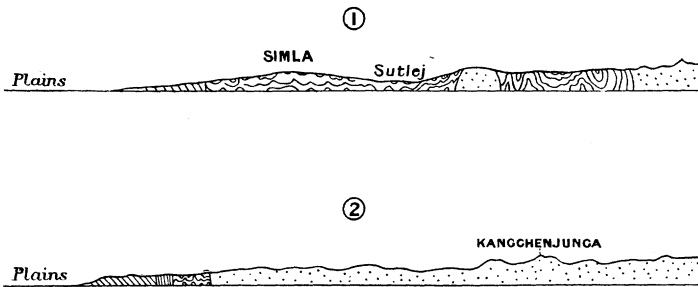


Fig. 4.

Whilst therefore there is evidence of compression in the Himalayas, I do not think that there is any evidence that the Himalayas have been elevated by compression.

My experiences have been confined to one region, and it is possible that they may not accord with the views of those who have studied mountains elsewhere. The problems involved will not be solved by one branch of science or in one locality. I hope that by expressing my own opinions I may induce others to express theirs.

Before the paper the President said : There is no need for me to introduce to you Sir Sidney Burrard, the late Surveyor-General in India, because he has already been before us this session. We are very glad to welcome him here again this afternoon, and I will now ask him to read his address.

*Colonel Sir Sidney Burrard then read the paper printed above, and a discussion followed.*

Dr. MORLEY DAVIES : The subject which Sir Sidney Burrard has introduced is one of very great difficulty and complexity, upon which the opinions of geologists have changed so much from time to time that it would be very unwise to be at all dogmatic. But there were certain views expressed by Sir Sidney Burrard on which I should like to comment. He refers to the rigidity of the Earth, and, pointing out that gravity acts in a purely vertical direction,

draws the conclusion that horizontal transference of matter cannot result from it. I am not a physicist, and I speak on matters of physics with great fear and trembling lest I should use terms inaccurately. But, from discussions with those able to judge, I gather there is no incompatibility between the Earth as a whole having the rigidity of steel and portions of it being susceptible to deformation of shape as the result of long-continued stress. Unfortunately, geological terms are largely influenced by the old ideas of the liquidity of the Earth, so that the term "undertow" is used to express the horizontal transference of matter in the depths of the Earth counterbalancing the lateral transport at the surface. But if we consider those supporting columns shown on one of the diagrams as extending to a depth of 70 miles, when there is a transference of matter from the tops of the mountains to the bottom of basins, the greater weight on the supporting columns of the basins will tend to make them bulge laterally. By lateral deformation of that kind I fancy that quite sufficient compensation can take place for the surface transport. But Sir Sidney Burrard's view of the adaptation of the supporting column to surface changes seems to credit the Earth with characteristics which have hitherto been regarded as confined to living organisms. One has always supposed that if you pile extra weight upon the ocean basins, the effect upon the density of the supporting columns beneath would be to increase it by compressing them, and if you remove large masses of matter by denuding mountains, the effect, if any, on the supporting columns, would be that they would expand and become lighter. But Sir Sidney Burrard's view is exactly the opposite: that when you remove pressure from the mountains the supporting column underneath, in order to restore isostasy, proceeds to become heavier, and the supporting columns under the ocean basins, when they become silted up, become lighter. I do not see how that can come about unless through some sort of nervous system which will enable the Earth to adapt itself in an indirect way. As regards Dr. Fermor's idea to which Sir Sidney Burrard has referred, of the elevation of mountains by molecular changes in the rocks beneath, there is this difficulty: it may explain how mountains and depths once formed are maintained, but not how they are initiated. It is one of the well-known facts of geology, that over and over again we find thick masses of sediment, all of shallow-water type, showing that the sea-floor has sunk just as fast as the sediments have accumulated. If we try to explain this by simple hydrostatic replacement, we are met with the difficulty that light material cannot depress the heavier layers below it to an extent equal to its own thickness. If, on the other hand, we try to explain it by actual compression of the deeper layers, the principle of isostasy is not satisfied, because the total mass of the supporting column is increased. But if you combine the two things—if you have the sinking taking place partly by displacement and partly by compression—then you can satisfy the principle of isostasy exactly. And the same thing applies, *mutatis mutandis*, to the elevation of mountains. So I can see how by combining displacement with compression or expansion you can continue to depress your depths or elevate your mountains, just as fast as the ones are filled up and the others denuded down, but I cannot see how you are going to start the process in either case. The only way to start expansion would be by a diminution of pressure, and that can only be got by denudation, and you must have mountains there to be denuded. What we want is a cause of mountain-elevation in a region where a depression exists, for all the evidence seems to show that the sites of mountain chains are previously occupied by deep sea.

Dr. HUME : This subject is of much interest to me, because we are seeking to obtain fuller information as to the origin of our mountain ranges in Egypt. I may briefly state how some of us in that country are approaching this question. Looking at the case of the Red Sea area, it certainly does appear as if a large anticline was originally formed there, giving rise to a continental surface. The beds composing it were formed during the Cretaceous and Eocene periods, and as they rose above the sea to become the land surface, they were eroded into ridges and depressions. Two methods of obtaining deeps have been mentioned. Another suggestion may be offered. It seems probable that when an anticline of great breadth is rising, it does not do so as a whole, but is thrown into a series of secondary folds. This would explain the presence of such depressions in the Red Sea area, and might help to do so elsewhere. In the region bordering the Gulf of Suez the mountain ranges on both sides are very conspicuous. I have traced their boundaries over large areas both in Egypt and Sinai, and have found that the strata are tilted against the granites and other ancient rocks at extremely high angles. Two explanations have been submitted for such occurrences. One is Prof. Gregory's suggestion of vertical subsidence, the other the view expressed by Dr. Ball that compressional stresses can alone have caused the conditions observed. To me uplift has seemed the most satisfactory explanation of the higher ranges. Between them is a series of folded strata, the condition mentioned by Dr. Morley Davies being observed in the basin portion of the folds, viz. the presence of great thicknesses of gypsum and salt (at least 3000 feet in places), while immediately adjoining them are the lower granitic ranges, in which we also see evidence of uplift also. These points require further discussion, but at present the differences in height between the Red Sea Hills and Sinai Mountains (7000 and 8500 feet respectively above sea-level in round figures) on the one hand, and the lower ranges (only 1400 feet above sea-level) on the other, seem best explained by vertical or lateral uplift as described by Dr. Morley Davies. We have as yet insufficient data to consider the phenomena in relation to isostasy.

Dr. HAROLD JEFFREYS : I agree entirely with Dr. Morley Davies's remarks. We all know of scientific theories that were once widely accepted, and have since been abandoned. I think the thermal contraction theory of mountain-building is on the opposite footing, that of a thoroughly sound theory, capable of fulfilling all demands on it, which has been dropped for no satisfactory reason, and should be restored. Osmond Fisher's estimate of 100 feet for the greatest possible height of the mountains that could be produced by thermal contraction was obtained by finding the volume of rock that would be crumpled up on the theory, and assuming this rock spread out uniformly over the surface of the Earth. His estimate of the height of the mountains is the depth of this deposit. But if all our known mountains were powdered and spread out uniformly over the surface of the Earth, they would not cover it to a depth of anything like 100 feet. The proper way of carrying out a comparison is to find the *area* of the Earth's surface that would be crumpled on this theory, and to compare it with the reduction that appears to have taken place in the formation of mountains. I carried out this comparison in a paper in the *Philosophical Magazine* for 1916, and found that the compression available was about twice that needed. Apart from this mistake, it was clear that Osmond Fisher's work needed revision from the discovery of radioactivity, which upset the whole of the Kelvin theory of the cooling of the Earth, upon which Fisher based his argument. Taking radioactivity into account, Holmes found it possible to

satisfy all the thermal conditions required by geology, and it is on his numerical results that my estimate was based.

I do not think that a contracting Earth would necessarily wrinkle either in all ages or in all parts. This argument seems to leave out of account the strength of the Earth's crust. A small contraction would only cause a small horizontal stress on the outer layers, which could be sustained without change of shape. Crumpling does not start until the stress has become so great that the strength of the crust is no longer enough to support it, and when once it has started it must spread. Thus the fact that all the chief mountain ranges were uplifted in one geological period is a natural consequence of the contraction theory. The view that wrinkling would occur all over the Earth, again, seems to involve the assumption that all rocks have the same strength. On the thermal contraction theory, however, the suboceanic rocks are more basaltic and have cooled more than sub-continental rocks, and on both grounds must be stronger. It is very probable, therefore, that they could sustain stresses that would be enough to cause crumpling within a continent. It is quite possible that no considerable crumpling under the oceans has occurred to this day. This is confirmed by the existence of the Pacific type of mountains. When a compressed ocean floor abuts on a compressed continent, the first to yield will be the continent, and thus we get a long range, like the Rockies and Andes, running parallel to the coast.

The evidence quoted by Sir Sidney Burrard about the Western Ghats and Tibet certainly supports the idea that they were uplifted without compression; but if so, there is still more compression available to account for other mountains. I should like geological evidence as to the possibility of the transmutation of rocks to the extent required by the theory Sir Sidney has offered. The height of Tibet is about 10,000 feet, so that to get it uplifted on account of a ten per cent. change of density requires that the depth of rocks altered should be 100,000 feet, or practically 20 miles. I should like to know whether this is plausible. Gravity, of course, cannot produce horizontal movement; but if a column of rock at one place is heavier than a column of equal cross-section at another, the pressure at the bottom is greater, and the difference of pressure at the bottom gives rise to a horizontal force which can do all the moving of rock that is wanted. Without such horizontal transference isostasy could never be readjusted after denudation. For mere vertical expansion and contraction caused by changes of density does not affect the mass in a vertical column, and therefore makes no important difference to the distribution of gravity.

Dr. J. W. EVANS: We always welcome a paper by Sir Sidney Burrard, for we know what splendid work he has done in connection with the Geodetic Survey of India. We know that he has made India the foremost country in the world so far as concerns the study of the variations of gravity from point to point, and the good work is now being carried on by those who have come after him on the staff of the Survey. But of course we reserve the right to our opinions on the very difficult questions he has brought before us this afternoon. As he himself says, the problem we have got to consider is, Have the mountains been lifted by horizontal compression of the crust or by vertical uplift from below? Sir Sidney Burrard tells us that so far as his knowledge of the Himalayas goes there is no evidence that there were ever sedimentary strata which were arched over the granite masses which form the core of the mountains. That may be so in the case of the Himalayas, although I can scarcely reconcile it with a great deal I have read on the subject, but it is not true with regard to the portion of the Andes with which I am personally acquainted, nor of those

denuded mountain chains of which we can see the ruins, so to speak, in our own country. There we have every evidence that contraction and folding took place in long-distant days, and formed ranges of mountains probably no way inferior to the Himalayas, and most of the writers who have described the structure of the Alps have come to similar conclusions. Now Sir Sidney Burrard finds great difficulty in accepting this theory of the formation of mountains from folding due to contraction. His first difficulty is based on physical grounds. He says it involves, as is clearly the case, the movement of the surface relative to the interior. He says that this is entirely inconsistent with the rigidity of the Earth's crust, and indeed, of the Earth as a whole, which has been repeatedly proved by various considerations—by earthquake waves, by the effect of the attraction of the heavenly bodies and the variation in position of the terrestrial pole. These clearly demonstrate that the rigidity of the Earth as a whole is even greater than that of steel, and near the surface at least equal to that of steel. Now that is not in any way inconsistent with the possibility of a relative movement of the Earth's crust. Suppose I took a steel sphere and pressed it for a minute or two against a steel plate. The sphere would be distorted under the pressure, but when the pressure was relieved it would be restored to its former shape. It would behave as a rigid substance which possesses the quality of elasticity. But if the same pressure were to be applied, not for a brief period, but for a thousand years (or even less than that) it would be found that the steel was permanently distorted. For long-continued pressure, acting always in the same direction, results in progressive distortion, whereas pressure acting only for a short time leaves no permanent result. The vibrations of earthquake waves act only for a few seconds, and those of the heavenly bodies only for a few hours. But under long-continued pressure of a sufficient amount the substance of the Earth's crust, as is evidenced by the existence of the equatorial bulge, flows like pitch. The question next arises as to the possible cause of the lateral compression in the earth's crust. The difficulty to my mind is not the difficulty of finding a cause, but to choose amongst them. There is first the contraction by cooling of the Earth's interior, which was long considered to be insufficient, but, as you have heard, that by no means appears to be the case. But there are other possibilities. The interior of the Earth has been losing all through the geological ages an enormous amount of gas and volcanic products, and the result inevitably means that the volume of its interior is less than it was. There is still another cause that operates in the same direction. The Earth is believed to be slowing down, the velocity of its rotation is diminishing, and it is probable that the length of the day millions of years ago was very much less than it is at present. The result must be that the Earth approximates more closely in form to a sphere than before. We all know that the surface of the sphere is the least surface that contains a certain volume of matter; therefore, the more a body approximates to a sphere the less surface it has for the same volume. Its former crust would therefore be too large for it. There is yet another closely connected cause. If the centrifugal force is less, as it will be if the rotation slows down, the pressure on the interior of the Earth will be increased, and the interior will be therefore compressed and decrease in volume, and for this reason also the surface will be too great for the interior. There are other considerations, but I think I have said enough to show you that there is no difficulty in finding reasons for believing the crust of the Earth is becoming progressively larger relative to the interior. These explanations apply to the whole Earth, but there are also local causes affecting particular areas. In the first place, the slowing down of the Earth's

crust would cause the circumference of the equator to become less, so that the whole equatorial region would be exceptionally compressed, and we should expect in that region north and south lines of mountains to predominate. There is also the action of the Earth tides caused by the moon and the sun, resulting in an unequal retardation of the Earth's crust, and a general disturbance of the relative positions of different portions. We know that the Earth's crust is not uniform but contains a number of solid masses formed of ancient folded rocks where the crust is thicker than elsewhere and the strength greater. These are like masses of ice in an icefloe, and any such movement as I have suggested will alter the relative positions of these masses, giving rise sometimes to tension, sometimes to compression in the regions between them; the latter is, I believe, one of the most frequent causes of mountain building. I think I have said enough to show that those who believe in the contraction theory of mountains have not such a very bad case after all.

Sir Sidney Burrard argues that the presence of remains of elephant and rhinoceros in the Tibetan tableland was evidence that it had risen in recent times, and without any accompanying folding. I think I am right in saying that the former is *Elephas primigenius* (the mammoth), which lived in this country at the time of the Glacial Period, and the latter *Rhinoceros tichorhinus* (the woolly rhinoceros), which accompanied it. Both were as well capable of taking care of themselves under Arctic conditions as the reindeer.

It must not be supposed from what I have said that I do not welcome in the strongest manner a paper like this. I think that the problems of mountain building, of the variation of gravity from point to point, require more attention than they have yet received, and I hope that both topographical and geological surveyors and engineers generally will follow the example Sir Sidney Burrard has set, so that India will no longer be an isolated example of what can be done in scientific research on the Earth's interior, but that it may be taken as a pattern in every part of the British Empire. We have a wide Empire extending over a great part of the world, and I trust that we shall prove ourselves worthy of it, and show that scientific research will everywhere follow the flag just as surely as commerce is supposed to do.

Mr. HINKS: I have noticed that the geodesists always seem to accept, without any question, that depth of 70 miles which arises from Hayford's deductions, and in a few remarks after Colonel Tandy's paper I ventured to say that in my opinion those figures were exceedingly ill-founded. I welcome the opportunity of asking of the great experience of Sir Sidney Burrard, whether he is not able to agree with me. It is a technical point belonging to the theory of least squares. Hayford made five solutions, in which he took different values for what he calls the "depth of compensation." Those five values were first, zero; secondly, infinity; and third to fifth, quantities not differing very much from one another, but of the order of about 70 to 100 miles. He formed five solutions, and the sums of the squares of the residuals in his equations of condition were something like this in thousands: 65 for infinity, 13 for zero, and 8 for the other three depths. From the very slight difference between the three latter values he deduced that 70 miles was the most reasonable depth of compensation. A long and sad experience of least square solutions makes me think there is exceedingly little in this argument. Those sums of squares were so nearly alike in the three latter cases, that I don't think any reliance can be placed on the 70 miles; it is not impossible that say 160 miles would have given a more favourable result if he had tried it. I would submit then that there is no arithmetical reason for sticking very



closely to this 70 miles. Might I be allowed to call Dr. Evans' attention to a very brilliant lecture, which he has perhaps overlooked, by Osborne Reynolds, which startled Cambridge about 1903, and which was published afterwards in a little book called 'An Inversion of our Ideas concerning the Universe,' in which he described some beautiful experiments showing how a granular medium can expand under pressure?

Colonel Sir SIDNEY BURRARD: I feel I have a difficult task. I must first thank Dr. Hume for what he told us about the Gulf of Suez, which was extremely interesting to me. I have often seen it, and was glad to hear of the work he is taking on there. He is perhaps the only speaker to-night who has not taken me to task for something. My critics have this advantage over me, that they saw my paper beforehand, and I did not see what they were going to say. I will first refer to what Dr. Morley Davies said about under-tow. If you have isostasy in a crust, if there are different densities side by side in columns in a crust, it is evidence that the conditions in that crust are not hydrostatic; I think that geodesy has shown that the isostatic shell reaches down, I won't say exactly 70 miles, but to some depth of that order; below that depth there is possibly a hydrostatic core, but I do not think that hydrostatic conditions exist in the crust. Most of you know the experiments of Adams, who is the greatest authority now on the crushing strength of granite. When we are discussing the strength of the crust it is of no use considering the sedimentary rocks at the surface: we have to consider the granite shell underlying them, and Adams found that granite will bear 30 miles of a granite column before it crushes. He also found that small cavities will remain open in the crust at depths of 11 miles at temperatures of 500° Centigrade, and that these will remain open at greater depths if filled with water. Now with regard to what Dr. Davies said about the bulging of the sides of the columns and the lateral deformation of these vertical columns in the crust. I do not think that there is any bulging of the sides of those vertical columns, or any horizontal passage of matter through these columns, because wherever we test the compensation we always find it accurate, and this supposed bulging of the columns would destroy the accuracy of compensation. You would have extra density being bulged from a dense column into light columns. As far as we can see, compensation takes place, compared with geological time, very rapidly. During our own time on Earth we find that mountains and seas are already compensated, so this is a condition that supervenes perhaps momentarily. I do not think the idea that an isostatic shell must be very weak is based on any direct evidence. The existence of isostasy is supposed to prove that the Earth's crust is wanting in rigidity. But what really happens is that there is a tug-of-war between gravitation and rigidity. Gravitation tries to pull down Mount Everest, and the rigidity of the rocks resists the pull of gravitation, and there is a tug-of-war between them. You cannot say that gravitation has won, for there is Mount Everest standing firm. Something gives way in the crust, the column under Everest becomes compensated, and the tug-of-war ceases. With regard to the question of deltaic deposits in shallow water, great and deep deposits are said to have always been made in shallow water, and to have been always sinking and sinking; it has been held that they go on sinking under the weight of fresh deposits, and in some way or another this has become connected with isostasy. Captain Dutton, the American geologist, is often quoted in this matter. I think it is rather unfair on him to quote him now; he wrote forty years ago, when isostasy was in its infancy; he saw these deposits of great depth, and he connected them with isostasy, but now that Hayford has taught

us more about compensation, we see that the sinking deposits have no connection with isostasy. If you compress the crust, it does not help isostasy in any way. When a river piles up a huge delta on the crust, it does not produce isostasy if the crust is compressed. When a delta is being piled up, isostasy can only be brought about if the density underneath is decreased. What is the evidence that these deposits sink under their own weight? I do not deny that in rare cases they sink, but I question whether their sinking is due to their own weight. I have read of a case on the coast of Italy where there was a castle, and for some centuries (I am speaking from memory now) it sank under the sea and became covered with marine shells; it might have been argued that the weight of this castle was making the coast sink; but after a time it began to rise again and it now stands on dry land! I believe that the Baltic is now a sinking area, but it is not sinking under any surface weight. If you look at the big deltas of the Nile, the Ganges, the Mississippi, you will see that silt is being poured out into the oceans; and it is not sinking into the crust. The Tigris is gradually filling up the Persian Gulf, and Dr. Pilgrim, the geologist, stated that the shores of the Persian Gulf are actually rising at Bushire and Jask. The only delta, as far as I know, which is building up deposits in a sinking basin, is the delta of the river Helmand in Central Asia; there the deposits are very deep and are sinking, but they are not sinking under their own weight. This is a river which cannot find an outlet to the sea, and naturally it finds out the lowest point it can. Its deposits will be naturally formed at one level because if the crustal subsidence becomes more rapid at any time, the gradient of the river becomes increased and there are more deposits to fill the depression; if the subsidence ceases at any time the gradient becomes so slight that the deposits cease. Dr. Davies and Dr. Evans even went so far as to make fun of some of the geodetic theories. They, I think, said that they did not believe that pressure could produce a decrease of density. Dr. Davies said that I was giving nerves to the rocks, and Dr. Evans compared it to Einstein! I do not like to speculate on what goes on at great depths, but it seems to me, from the observations of geodesy, that there are isostatic columns in the crust and that their densities are readjusted by hydrostatic pressure from below. I say this with some diffidence, because I know that seismologists insist on a solid core. I was very interested to hear that Dr. Evans presses the idea of horizontal folds in the crust, and that he is supported by the mathematician Dr. Jeffreys; that is a formidable combination; if this meeting had been held forty years ago, mathematicians would have been against the geologists, and I acknowledge that geodesists must reconsider and see if they cannot reconcile their results with folding. One of the objects of a paper such as this is to bring out these opinions. Dr. Jeffreys referred to radium, but as far as I understand it, I do not know that radium has altered the old views of the Earth's cooling. These views were based on the temperature gradient in the crust, and that was determined by experiment. He also referred to the strength of the crust under oceans being greater than that under continents. But if you take a section of the Earth's crust, the surface features are seen to be extremely small, and when we deal with depths in the granite shell, there are no grounds for assuming the strength of the crust under continents and oceans to be very different. With regard to what Dr. Evans said, that changes in rotation-velocity produced contraction, we have to remember that we are not trying merely to find a cause for the Earth contracting as a whole; we want to learn why the core has contracted and not the crust. With reference to the discoveries of Richard Strachey in Tibet, I have never seen his deductions

questioned by Indian geologists. He has the reputation of being a capable geologist, and he was the man who found the fossil bones of elephants; the deductions I gave you were his deductions. But if Dr. Evans is right in saying that Strachey's elephant and rhinoceros were Arctic species, then I know that the argument for vertical elevation is weakened. With regard to what Mr. Hinks said concerning Hayford's depth of 70 miles, Hayford has devised a very remarkable system. All the theories which we put forward to assist scientific inquiry must be based upon observed facts, and that theory is best that fits the most facts; Hayford has produced a theory of compensation, and wherever you apply it it fits the facts, and this is a tremendous argument in its favour. He made this discovery from observations in America. We applied it in Tibet—quite a different part of the world and under different conditions—and we found it fitted. Two or three years after Hayford had introduced his theory, the geodetic world were anxious to see how the numerous observations in the Alps would respond to Hayford's methods; the Swiss geodesists reported that the mountains of Switzerland had moved about horizontally as shown by the geological theories, and that it was out of the question to expect to find them compensated, and that they did not think it necessary to go to the enormous trouble of Hayford's computations. So Hayford selected some of the Alpine stations himself and made the calculations himself, and he found his method suited the Alps accurately. Hayford's method has fitted the observed geodetic facts all over the world. It is a most difficult matter for each plumb-line station to have to calculate the compensation-effect of every hill on the earth. Think of the labour; and Hayford, in order to make such a system possible, introduced this depth of 70 miles. He is the only man who has shown us how we are able to compute the facts of the whole topography of the Earth for every geodetic station; he has shown that the effective compensation of the topographical features of the Earth's surface is concentrated at about 25 miles' depth.

The PRESIDENT: When we look up at the Himalaya mountains the height seems stupendous, and we think that the force needed to raise them to that altitude must be titanic. But these are days of "relativity." And relatively large as they appear in comparison with the size of a man, the mountains are relatively insignificant when compared with the size of the Earth as a whole. The average height of the Himalayan range may be taken roughly as 4 miles. The diameter of the Earth is about 8000 miles. On this 15-inch school globe which I have before me the Himalayan range would be represented by a protuberance not more than  $\frac{1}{133}$  inch high—that is about the thickness of a thick sheet of note-paper; and any ordinary mountain range would be represented by a rise of the thickness of a thin sheet of note-paper.

What we have to account for is the rise of these insignificant elevations of the Earth's surface. And we have no need to seek for a force capable of raising these eminences in one sudden effort. The process of elevation is most gradual, for we know that it has taken at least a million years to raise one of the greatest mountain ranges. A fair way, therefore, of stating the problem would be this: "What is the force which can, in about a million years, cause an elevation on the Earth's surface not greater in proportion than the thickness of a sheet of note-paper to a school globe?" When thus stated the problem has a less formidable aspect than it presents to us when we stand under a Himalayan giant and wonder what titanic force must have been at work to raise these mountain masses to such stupendous heights. Now in seeking a solution of this problem, we must take regard of two facts of fundamental importance—

firstly, that the Earth is a highly sensitive body, quickly responsive to outside influences ; and, secondly, that it is part of the whole great Universe with which it is intimately connected and from which it is unceasingly receiving impressions. When we are considering happenings to the *surface* of the Earth the importance of these two facts will be at once recognized. Sir Sidney Burrard insisted on the solidity of the Earth and upon the crust being as rigid as steel. And this may be perfectly true. But it is also true that the Earth in its ultimate composition is made up of particles of matter—electrons—which in the quite literal sense of the word are in *unceasing* motion and which are sensitively responsive to outside influences. The crust of the Earth may be as rigid as steel, but it has not by any means those characteristics of immobility and irresponsiveness which the rigidity of steel suggests. Within it is in a fury of activity. The Earth is entirely composed of these self-active electrons, mere centres of energy, which group themselves together as atoms and groups of atoms in ever-increasing complexity, but which are all alike and all very sensitive. The Earth is therefore a very impressionable body. So when the powerful influences—like light and radiant heat from the Sun—come raining down upon the Earth they do not pour off the surface like rain off a duck's back ; the impressionable Earth absorbs them and responds to them. The Earth—and, of course, more especially the surface of the Earth—quickly responds to the impressions it receives from the outside Universe ; and the results of the interaction of the Earth with the rest of the Universe we may see all round us to-day. We may select from among these results some which indicate the existence of forces which uplift bodies in defiance of the force of gravitation dragging them down.

One example we may take is a cloud. Despite the tendency to gravitate towards the centre of the Earth drops of water are raised under the influence of the sun to heights higher than the highest mountain. Trees furnish another example. Responding to the light and heat in the Sun, and to other influences bearing upon them from the Universe, particles of the Earth's surface raise themselves upward in the form of trees and maintain themselves erect for hundreds of years. Clouds and trees are instances of the way in which the sensitive particles of which the surface of the Earth is composed, responding to and in interaction with the various forms of energy in the Universe at large, have elevated themselves to great heights in dead opposition to the downward-dragging tendency of gravitation. May not these examples give us the clue to where to seek the force which raises mountains ? May not the slight upheavals on the Earth's surface be due to the sub-atomic energy locked up in the rocks in interaction with cosmic energies of many kinds ? May not the elevation of mountains be due to the activities of highly sensitive electrons acting in response to the impact of energies incessantly pouring in upon the Earth's surface from the Universe at large ?

What I would suggest is then that if we want to find the force which uplifts mountains we should look for it in the heart of the atom and in the heart of the Universe as they interact upon another. As light and heat and all the other forms of energy which go to convert the hydrogen and oxygen atoms of the Earth's surface into water, and inorganic compounds into organisms, impinge upon the electrons which compose the Earth's surface, the electrons group and re-group themselves into atoms of differing elements, while the atoms in their turn group themselves into varying compounds. And from this interaction between the Earth and the rest of the Universe there result those heterogeneous mixtures of rock which compose the crust of the Earth, and those

physical and chemical changes—those variations in the volume and density of the rocks—to which Sir Sidney Burrard has alluded and to which he attributes the elevations of the Earth's surface.

The atoms would always be tending to gravitate towards the centre of the Earth. But the evidence of clouds and trees shows in that the concentrating tendency of gravitation is more than balanced by an excentrating tendency impelling the atom to fly *outward*—that is, to those appropriately situated, *upward*, and from the operation of this force will have emerged those elevations of the Earth's surface which to us appear great heights, but which in reality are only of the order of the thickness of note-paper in comparison with a school globe. So it is in the interaction of our highly impressionable and responsive Earth with the multifarious energies of the Universe at large that I suggest to you we shall find the ultimate origin of mountains. From this cosmic interaction—the action between Earth and the other parts of the Cosmos—is generated an excentrating, uplifting force (or complex of forces) which, acting in successful opposition to the concentrating, lowering force of gravitation, raises mountains as it raises clouds and trees.

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## THE ROSS SEA DRIFT OF THE "AURORA" IN 1915-1916

J. M. Wordie

THE story of how the *Aurora* broke away from her moorings at Cape Evans, Ross Island, on 6 May 1915, and drifted helplessly in the pack ice for nearly a year, has already been partially told by Sir Ernest Shackleton in 'South.' The extracts which he gives from her captain's log were selected to illustrate how the party carried on during the winter and the ensuing summer before the ship was free again, and in a more or less crippled condition finally reached New Zealand. References are made to her position from time to time sufficient to give a fair idea of her track. A somewhat similar story, based on a newspaper report, is told by Dr. Mill in the *Geographical Journal* for 1916 (vol. 47, pp. 372-374). Commander Stenhouse, however, the captain during the drift, very wisely thought that the full and correct details of the ship's drift should be made available, and to this end gave me his diary last spring, at the same time asking me to work out the course, etc., with a view especially to comparison with the *Endurance* and the other Antarctic drifts.

The material available consists of a type-written copy of his diary made in New Zealand in May 1916, and a list of corrected longitudes from October 1915 to April 1916. Unfortunately, many of the loose sheets of the diary, most of them dealing with the first month of the drift, are missing. Commander Stenhouse volunteered to get the original sent over from New Zealand, and telegraphed and wrote accordingly, but without satisfactory result: the original may eventually be found, and if so will of course add a few more details. A more serious loss, and which cannot be made good, is that of a bundle of diagrams and drawings, some

## THE MOUNT EVEREST EXPEDITION

AT the time of writing the last news of the Mount Everest Expedition is given in the telegram despatched by Colonel Howard-Bury from Tingri Dzong on July 16 by runner to Phari, and published in *The Times* of August 17.

On the last stage of the journey to Tingri further difficulty had been caused by rinderpest in the valley of the Bhong Chu, apparently the name of what has been shown on the maps as the principal western branch of the Arun, though, from a reference to Kharta as "a collection of villages in the Arun valley," it is clear that the map is seriously wrong. The only transport to Tingri was by donkey, and the possibility that no yaks might be obtainable for the mountain party caused us some anxiety, now happily relieved by the news that Messrs. Bullock and Mallory had left Tingri on June 23 with 18 coolies and 4 yaks for the first exploration of the mountain's north-western face.

The base camp was established at Tingri, with headquarters in the Chinese rest-house assigned to the party by the Tibetan authorities, who have continued to show all friendly courtesy to the expedition. From the photographic dark-room installed there Colonel Howard-Bury has sent home a large first consignment of pictures taken on the way, which are now exhibited in the photograph-room of the Society. We hope to publish in the *Journal* for October, and thenceforward monthly, a selection of these pictures, and as soon as possible a map based on the work of the surveyors, whose results we await with some impatience, for it is at the moment quite impossible to follow the reports of the expedition.

The first disposition of parties was as follows: Captain Wheeler, of the Survey of India, was starting his photographic survey at Tabra (Keprak on the map, near the Pusi La), and Mr. Heron of the Geological Survey was with him, or near by. Major Morshead was working north to connect with the surveys of Colonel Ryder on the Brahmaputra. Mr. Wollaston, who had reached Tingri on June 22 after leaving Mr. Raeburn to convalesce at Lachen, was busy collecting the rich flora and fauna of the Tingri district, and intended to extend his work to the interesting neighbourhood of Gosainthan. Colonel Howard-Bury, in a letter from Tingri dated June 25, proposed to leave on the following day to visit the Pusi and Khombu (Pangu) passes and Lapche Kang, "a sacred place of pilgrimage where the old Sanskrit poet is buried," and then tour along the base of the 26,800 and 25,000 peaks until he found the mountain party, returning thence to Tingri.

The last telegram, of July 15, must have been sent on the completion of this programme, but covers only the early history of the mountain party, who had established a camp at 18,000 feet on a shelf above the left-hand margin of the Rongbuk glacier, and on July 5 had climbed a

23,000-foot peak above their camp, as a training excursion for the coolies. The north-western face of Mount Everest has an almost sheer cliff of 10,000 feet to the head of the valley, with difficult rock below the summit of the peak : so that even if the cliffs could be turned, the north-western face did not appear promising. About the end of July Colonel Howard-Bury proposed to move his base to Kharta and reconnoitre the north-eastern and eastern faces, which seem to be less steep, with more snow.

While the topography of the whole region remains very obscure, the cablegrams from the chief of the Expedition picture to us a land far from inhospitable, with large monasteries and villages hitherto unknown ; valleys with soft grass and bubbling springs ; hermits and nuns in cells or caves under the very precipices of the mountain ; wild animals and birds coming to feed from the hand. In this idyllic place the mountain party—sadly reduced by the death of Dr. Kellas and the illness of Mr. Raeburn—have found themselves facing 10,000-foot precipices which bar the way. How greatly will they on their return regret that the painter and the poet could not this year be added to the strength of the party !

Colonel Howard-Bury reports that up to July 7 the weather had been very favourable for the reconnaissance and for the surveys. The following week gave hail and rain, with snow at the higher camps, but by the end of July the north-west face of the mountain would have been sufficiently explored.

We have every reason to congratulate the Chief of the Expedition on his excellent progress in spite of unexpected difficulties. The 300 miles from Darjeeling to Tingri was covered in thirty days, which included several of enforced delay. No time was lost in getting to work from Tingri. The mountain party were at the base of the mountain well before the end of June. By July 16 the surveyors had mapped 6500 square miles of country ; the photographic and geological surveys were well in hand ; the natural history collections abundant ; the despatch of photographs from the expedition already well begun. All promises well for a highly successful first season, even though it is already clear that the mountain will not disappoint the mountaineers by proving unexpectedly easy.

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### MEMORIAL TO SIR CLEMENTS MARKHAM

THE Peruvian Government did a signal honour to Sir Clements Markham and to the Society when they asked permission of the Council to erect at the door of the Society's House a Monument to the memory of our distinguished ex-President. The proposal being gratefully accepted, the Peruvian Legation commissioned Mr. F. W. Pomeroy, R.A., to make a bust in bronze, which has been placed on a pedestal of Istrian marble in the bay to the right of the door.

The author, in order no doubt to find the flowers at their best, made a great part of his journey in the summer, and consequently suffered considerably from wet weather and from insects. The future traveller in this region would do well, if he is not specially interested in botany, to time his travels for the drier winter months.

A few small errors may be noted. Should not the Feng-shui-ling of chapter iii. be Fen-shui-ling, *i.e.* Watershed Range? I should not like to assert this positively, but the latter name is very common in China, and seems the more probable of the two. The photographs of "Cane bridge over the Ngawchang River," and "The Monastery, Putao Village," have been transposed, and consequently the wrong page numbers are given in the List of Illustrations at the beginning of the book. In the footnote on p. 42, "Appendix II." should be "Appendix I."

Such small mistakes are scarcely worth mentioning, and do not detract from the value of a most interesting book of travel in a hitherto undescribed country. It is much to be hoped that Captain Kingdon Ward will continue his explorations on this frontier, and will give us the result of his observations in some more volumes of this kind. There is still much unknown ground here.

H. R. DAVIES.

**Early Travels in India, 1583-1619.**— Edited by William Foster, C.I.E.

Oxford: University Press. 1921. 12s. 6d. *net.*

**British Beginnings in Western India.**— Hugh George Rawlinson. Oxford:

Clarendon Press. 1920. *Sketch-maps and Illustrations.* 7s. 6d. *net.*

The pioneers of British enterprise in the East have always been prime favourites with the students of the great ventures of our countrymen in foreign parts. Alone, or by twos or threes, they made for the centres of a society and civilization entirely strange to them, and there, in the midst of danger and difficulty, they compassed their aim with a courage, pertinacity, and resourcefulness which bequeathed an easier task to their successors. Amid all their anxieties, too, they kept their eyes open to the characteristics and resources of the different parts of India which they visited, and to the vivid and picturesque style of their narrative can be added the general accuracy of their observations, to which modern investigators have borne witness.

Until the recent publication, under Mr. Foster's editorship, of Sir T. Roe's account of his mission to Jehangir, the record of these experiences had to be sought for in the numerous and portly volumes of Hakluyt and Purchas, or traced to rare or forgotten pamphlets. Now that the relations of this country to India are entering, in certain aspects, a new phase, a brief account at first hand of how those relations were first established is opportune. The editor being again Mr. Foster, it may be safely assumed that the selection of the travellers and the arrangement and annotation of their letters or journals are what they ought to be. Particularly useful is the fitting of each contribution into the picture by means of a short prefatory biography. There is thus presented a general view of life in the Mughal dominions as it appeared to seven intelligent, and on the whole sympathetic, Englishmen of an era of high adventure. The field of their survey was comparatively limited since they all made straight for the court of the Emperor, which ranged between Lahore and Ahmedabad though resting longest near the western bank of the Jamna. A few entered India from the north-west, but most landed at Surat and made their way up country by the Tapti and Central India, or by Ahmedabad and Ajmir. Some, again, like Fitch and Withington, took opportunities for lengthy excursions to Pegu and Lower Sind respectively, but their business



was to stick close to the court until they had secured the trade or the concession they wanted. Notwithstanding wide differences in personality and opportunity, the travellers are in general agreement as to essentials. The accounts given by the merchants show the greatest sameness, while the most comprehensive and circumstantial narrative is that of the chaplain Terry, who, though he saw less of India than the rest, had the privilege of being for some months the host of the incomparable "globe-trotter," Tom Coryat. The two letters from Coryat himself are especially interesting, as Mr. Foster has reproduced them from the original pamphlets, whereas Purchas made extracts only. So, too, in the case of Withington, the editor has supplied a full reprint of the original diary. The aid of scholars of to-day has been enlisted abundantly in the elucidation of names of places and people and in the transcription of the Indian words generally. The work, then, may be summed up as an interesting and convenient guide to an important phase of our early efforts at peaceful penetration.

Mr. Rawlinson's book and Mr. Foster's are complementary to each other. The one depicts the efforts of the early travellers to find out what were the resources and trade openings of India, and then to negotiate for a footing in the country; the other is, as it were, an intensive study of that footing when gained, and the uses to which it was put. In regard to the earlier years, therefore, the authors cover a good deal of the same ground, though Mr. Rawlinson is less concerned than Mr. Foster with events in upper India. The general object of the pioneers was to establish a centre through which to tap the trade of India, and to secure a share in the then more lucrative spice trade with the Far East. This implied a challenge to the maritime supremacy of Portugal in Eastern waters. For all these purposes, Surat was the most convenient port. It was the main export centre of the Mughal dominions, the gate of Mecca for Muslim pilgrims, and was surrounded by country rich in natural products and manufactures. Some years passed, however, before the obstacles raised by the Portuguese were overcome. In the long run, British merchandise prevailed over Jesuit diplomacy at Agra, and, after varying fortunes, the Portuguese fleet was driven south, and "got into a hole called Bombay," a hole then meaning merely a safe anchorage, without any aspersions upon the adjacent settlement. Sixty years later the position was reversed, and British headquarters were formally transferred from Surat to "the better hole."

The book is well written and put together. Having access to the records of the East India Company both in India and in London, the author is able to correct many mistakes found in the works of his predecessors. By judicious selection, too, from the somewhat diffuse contemporary authorities, he concentrates the attention upon one highly important phase of our relations with India, on which he will be found a helpful guide. In one or two points of no particular moment he is open to criticism. For instance, he attributes greater authority to the Partition Bull of 1493 than is now generally allowed to it (cf. *June Journal*, pp. 435-433). Again, it is not safe to accept Terry's hearsay account of the burial of poor Tom Coryat at the mouth of the Tapti, about 12 miles from Surat. At all events, about half a century ago, there were remains of tombs not far from the north-eastern gate of the city, which tallied with the account given by Herbert of the place of Coryat's burial; but they were swept away by floods about 1887. Finally, neither of the two English factories can now be traced, though the sites are known approximately and are covered by modern houses.

J. A. B.

being discovered in an Indian state ruled by a native chief. An engineer came to the chief and said he had discovered enormous quantities of oil in his State. The chief said, "Are you certain that there are enormous quantities of oil in my State?" The engineer replied, "Yes, quantities all over the State." The chief replied, "All right, let it remain there then." It is satisfactory to know that the Egyptian Government do not intend to let it remain there, but to let it be used for the good of mankind. I am sure you would like me to thank Dr. Hume on your behalf for his valuable lecture. Colonel Lyons has referred to his accuracy. There are some travellers who speak the truth, but not the whole truth, and there are others who speak a good deal more than the truth; Dr. Hume is one of those who do not speak the whole truth, because if he had told us everything we should have perhaps realized more vividly what are the hardships and risks which travellers in those deserts have to undergo before they bring back to us here the valuable information such as we have had this evening. On your behalf I beg to thank Dr. Hume for his most valuable lecture.

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### THE MOUNT EVEREST EXPEDITION

THREE long cablegrams and a beautiful series of photographs have been received from Colonel Howard-Bury, but not even the slightest sketch-map has come from the expedition, though the officers of the Survey of India were reported some time ago to have surveyed 9000 square miles of country. Without any map, except that which has been pronounced valueless, and which in any case shows few of the names, we are in the necessity of making a work of imagination to accompany the promised photographs in this number of the *Journal*. It has been a pleasant exercise to piece together the scattered details of topography from the cablegrams and the titles of the photographs, and to hang the patchwork on the rare points fixed by the Survey from the plains of India.

By way of running comment on the photographs we may summarize here the earlier stages of the expedition, which left Darjeeling on May 18 and 19 to cross the Tista valley and climb the Jelep La. In the pouring rain of this tropical valley photography was difficult, but there is a picture of the rhododendrons on the path which broke the Government mules. Once over the Jelep La into the Chumbi valley, the rains and leeches were left behind; but on the long ascent to Phari at the head of the valley the mountain dysentery attacked and weakened the older members of the party, which lost its most experienced mountaineers by the death of Dr. Kellas on the pass before Kampa Dzong and the breakdown of Mr. Raeburn, who was sent down from Kampa Dzong on June 6 to Lachen; was left there by Mr. Wollaston in charge of an assistant surgeon; and that is the last that any one has heard of him.

The Tibetan's strange genius for architecture is shown in every photograph of a building that comes to hand. The wall and towers flanking

the glacia of Kampa Dzong ; the fort at Tinki beside its lake of waterfowl (Plate 4) ; the magnificent range of monastic buildings on the hill of Shekar Dzong (Plate 7) ; or the sumptuous country house at Lumeh in the Rongbuk valley near Mount Everest (Plate 10), are the work of no mean architects, in a style severe and stately which seems at first sight unrelated either to Chinese or to Indian, but a great deal better than either. As a bye-product of the expedition we must have a monograph on this art from a sympathetic pen—say by one of the architects of Imperial Delhi.

On leaving Kampa Dzong the expedition was in new country, never before seen by Europeans ; very high, but open and easy country, with sympathetic if inquisitive villages, and officials who interpreted in a spirit of liberal courtesy the orders from Lhasa for facilities to the expedition. We have photographs from above the Tinki pass looking back over the country through which the expedition passed (Plate 5), and others from a hill overlooking the junction of the Yaru and the Arun (Plate 6) ; the place where they marched, “dressed as if for a gas-attack” over quicksands in a sandstorm. But without a map the photographs are tantalizing and unintelligible.

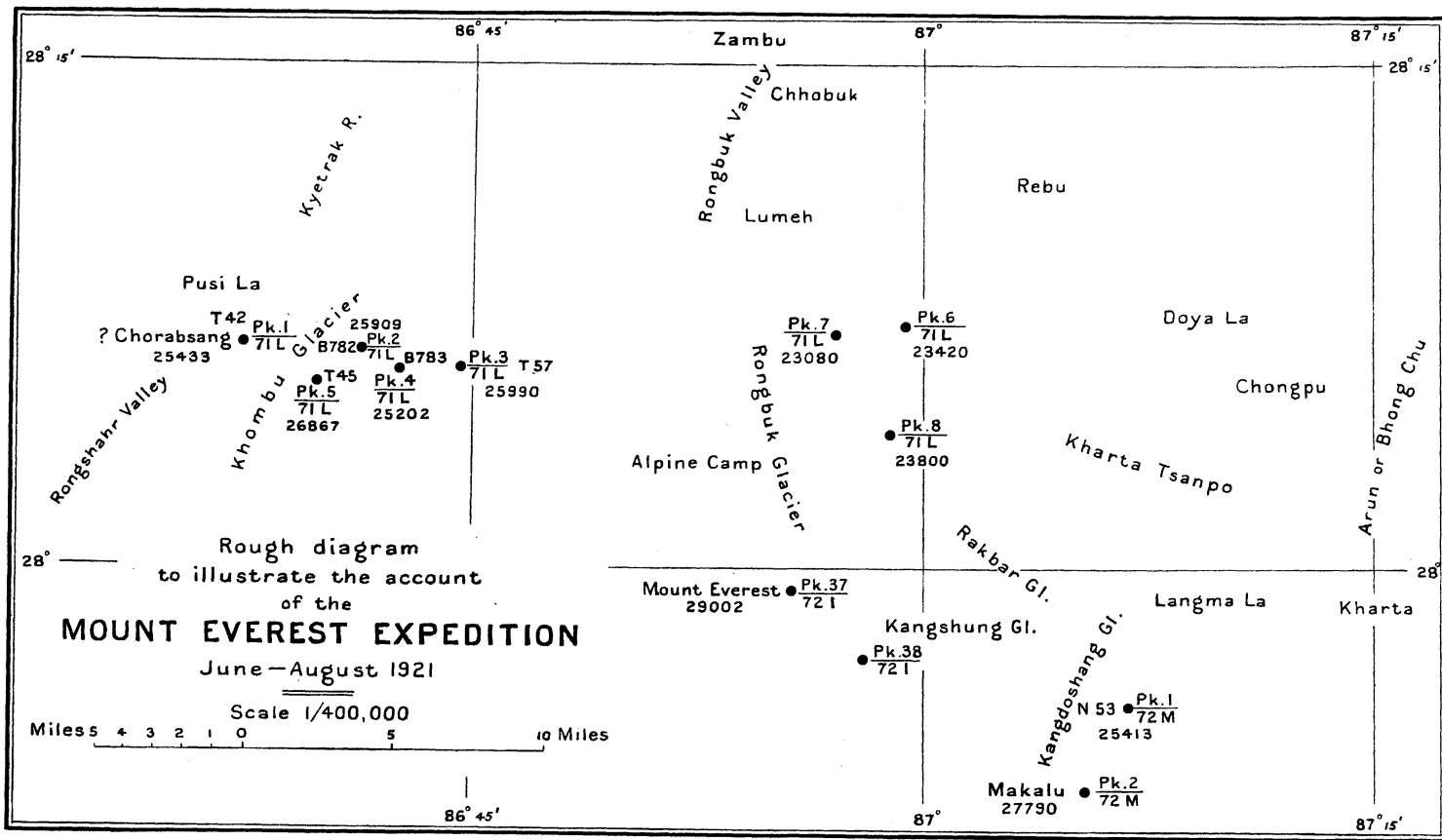
All the way to Tingri the travellers had Mount Everest far on their left flank. The glacier-fed tributaries and the Bhong Chu itself were all at that season unfordable, so that no more direct approach to the mountain could be found. The road even made a diversion some way north out of the main valley to Shekar Dzong, of which the cablegram published on July 28 gives a most interesting account. The photograph in Plate 7 shows in the foreground the Chinese tent pitched by the Dzongpen of Shekar for the entertainment of the expedition. Halfway up the hill is the monastery with 400 lamas, connected by walls and towers with the fort above, and again by further walls to a “curious Gothic-like structure” on the summit, where incense is burnt. An excellent photograph of the Abbot, taken by Colonel Howard-Bury, has spread the fame of the expedition, and prints have been begged for monasteries all over the country.

With the arrival at Tingri on June 19 the initial stage was safely passed, and parties got to work at once. Mr. Wollaston, by forced marches, reached Tingri on June 22 from Lachen : on the following day the mountain party of Messrs. Bullock and Mallory left for Mount Everest, and on June 24 Captain Wheeler and Mr. Heron started for their surveys of the Khombu glacier district. On June 26 Colonel Howard-Bury followed them : visited the Khombu glacier and pass to take the admirable photographs which we reproduce ; went over the Pusi La into the Rongshahr valley, and down the gorge shown in Plate 21 ; then marched east to visit the Alpine camp in the Rongbuk valley, and after a visit to Kharta returned to Tingri on July 11. So far as we can judge, all the photographs in Plates 9 to 22 were taken on this journey.

The first march from Tingri towards Mount Everest leads to a bridge over the Kyetrak glacier-stream from the Khombu glacier. This is apparently the stream named Keprak on the Indian 1/M map. The bridge is probably the same as that described in a later telegram as at Netsogu. The second march leads to Zambu, whence from a neighbouring hill the important photographs 11 and 12 were taken. The monastery of Chhökuk, with a bridge over the Rongbuk stream, must lie near Zambu. Lumeh, with its fine house (Plate 10), must be some distance up the Rongbuk valley, and somewhere in the same neighbourhood is the large Rongbuk monastery at 16,500 feet. The snout of the Rongbuk glacier, covered with moraine, and shown in Plate 13, is presumably higher up the valley, but not far, for the Alpine camp "on a sunny shelf high above the left bank of the Rongbuk glacier" is only 1500 feet higher. From Zambu to Mount Everest is said to be 22 miles: the Alpine camp 7 miles from the summit, and also 7 miles up the valley from an unspecified point, probably the Rongbuk monastery. Hence Chhökuk, Lumeh, and the monastery must all lie within 7 or 8 miles of the hill from which photographs 9, 11, and 12 are taken. This is the valley where birds and beasts are tame, and the burkel come down every morning to be fed by the hermits.

Zambu is described as north of Mount Everest, but is probably a good deal west of north, if one may conclude anything from the following argument: From a point 22 miles due north, and height 17,000 feet, the two peaks Pk. 6/71 L (23,420) and Pk. 7/71 L (23,080) should be seen just to the left of the mountain, and at a little higher elevation. The peaks lettered AF and AH fulfil this condition, except that they are too far to the left in comparison with their distance apart; and that AF appears rather higher than AH, instead of the reverse. But if the view point is north-north-west the configuration comes right. Now compare with Plate 12 from nearly the same point, but looking up to T<sup>57</sup> or Pk. 3/71 L (25,990), lettered BA on the plate. What are the mountains to the right? The scale of the second picture is evidently, from the foreground, greater than that of the first; but on no reasonable assumption for the view-point does it seem possible to fit Peaks BB, BD, and BC on photograph 12 to the positions of the peaks west of 3/71 L on the triangulation chart of the Survey of India: BB is too far from BA, or BD too near BB. Reference to Synoptical Vol. 35, shows however that Peaks 2 and 4 of sheet 71 L depend each on a pair only of rays, and their heights each on a single observed angle of elevation; therefore they may very well be spurious. The same is true of Peaks 6 and 7 in this sheet, but they are reasonably confirmed by the photograph. The conclusion is that the peaks on Index sheet 71 L are of doubtful value to the problem. We have provisionally assumed that BD is Pk. 5/71 L (26,867) or T<sup>45</sup>.

Turn now to the detail at the head of the valley, in Plates 13 and 14. The peak AA must be near 26,000 feet. Can it be the dark rock peak seen by Mr. Freshfield from the Chunjerma La, and photographed by Dr.



Kellas last December from the Kang La? (see *Geog. Journ.* for April last). Its eastern snow-slope is against the identification, and Dr. Kellas' results convinced him that the rock peak is further east. But it is interesting to note that Dr. Kellas' photographs seem to show the head of this valley. One thinks to identify with some confidence on the originals the small peak AB and the long ridge running south-west from it; and to make out that this ridge sinks to a comparatively low col before it joins the massif of Mount Everest. The similarity of detail is striking; but there are grave difficulties in accepting the identity. One may, however, with fair certainty identify the much-discussed "snow-dome" with Peak 8/71 L (23,800), which is hidden by Peak 7 (AF) in our photographs; and one may hazard the identification of the snow-peak to the right with AH; but the "wedge of light-coloured rock flecked with snow" is not to be found on our photographs.

We have as yet no details of the reconnaissance made by Messrs. Bullock and Mallory; but it is easy to see that the whole of the northern and western faces of the mountain are desperately steep, not inviting a first attempt on those sides. The peak of 23,000 feet they climbed must have been AO or AP. Unfortunately their photographs seem to have been unsuccessful, and we must wait for the results of Captain Wheeler's photographic survey. The climbers had a plan of crossing into the valley of the Kharta-Tsanpo by a high pass eastward, perhaps between AA and AC; but frequent snow, and great doubt of where they would come out, made them think better of it.

There is a great gap in our knowledge of the country between the head of the Rongbuk valley and the head of the Khombu glacier, some 18 miles west. In his letter before starting thither Colonel Howard-Bury spoke of an intention of working along the base of the intervening peaks until he found the Alpine party; but his cablegram says only that he "moved over" there, and no photographs have come to hand to suggest that he got into the Rongbuk valley otherwise than by way of Zambu, or that he approached Zambu otherwise than by the bridge over the Kyetrak at Netsogu.

Thanks to the admirable photographs he made on his tour of the parties, our knowledge of the Khombu glacier and pass is more detailed than that of any other region at present. The Khombu pass (19,000 feet) is "used to a certain extent by Nepalese traders, but usually there are a good number of casualties every year." The road from Tingri seems to keep west of the Kyetrak river. There is a photograph (Plate 15) looking across the valley from a hill above the bridge—perhaps not the bridge at Netsogu—and a whole series of pictures shows the succession of peaks on the eastern side of the glacier. The tributary glacier from Peak 5/71 L (26,867) is clearly visible on Plate 17; but no glacier from Mount Everest runs westward to the Khombu. Somewhere in the neighbourhood is the fine peak Chorabsang (Plate 22)—a new name

**PHOTOGRAPHS BY LIEUT.-COLONEL HOWARD BURY, D.S.O.,  
CHIEF OF THE MOUNT EVEREST EXPEDITION**



**1. RHODODENDRONS ON THE JELEP-LA LEADING INTO THE  
CHUMBI VALLEY FROM SIKKIM**



**2. GALINKA VILLAGE IN THE CHUMBI VALLEY**

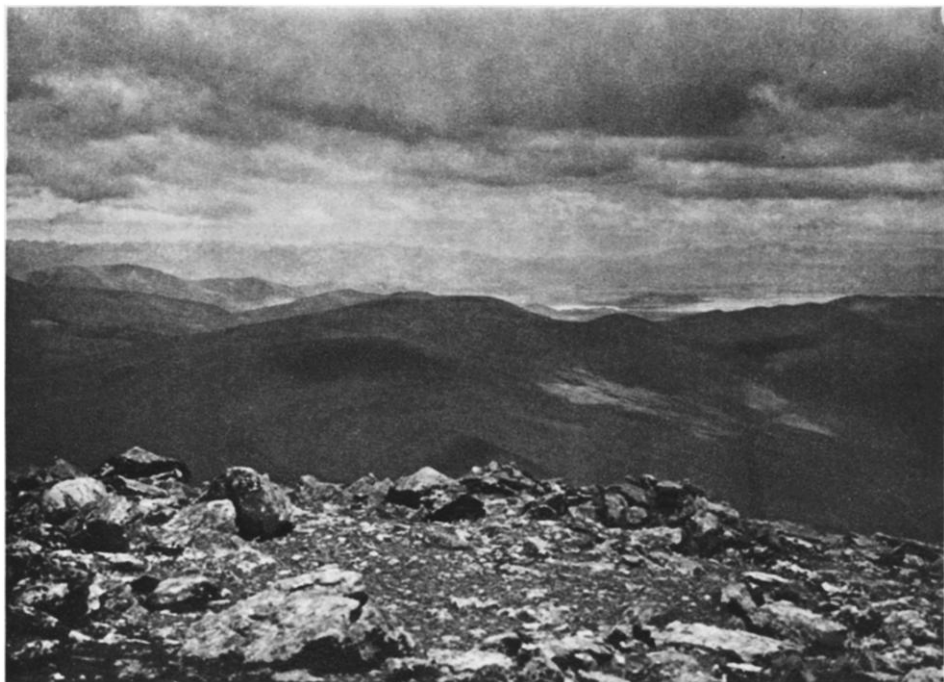


3. THE CAMP OF THE EXPEDITION AT KHERU



4. TINKI DZONG

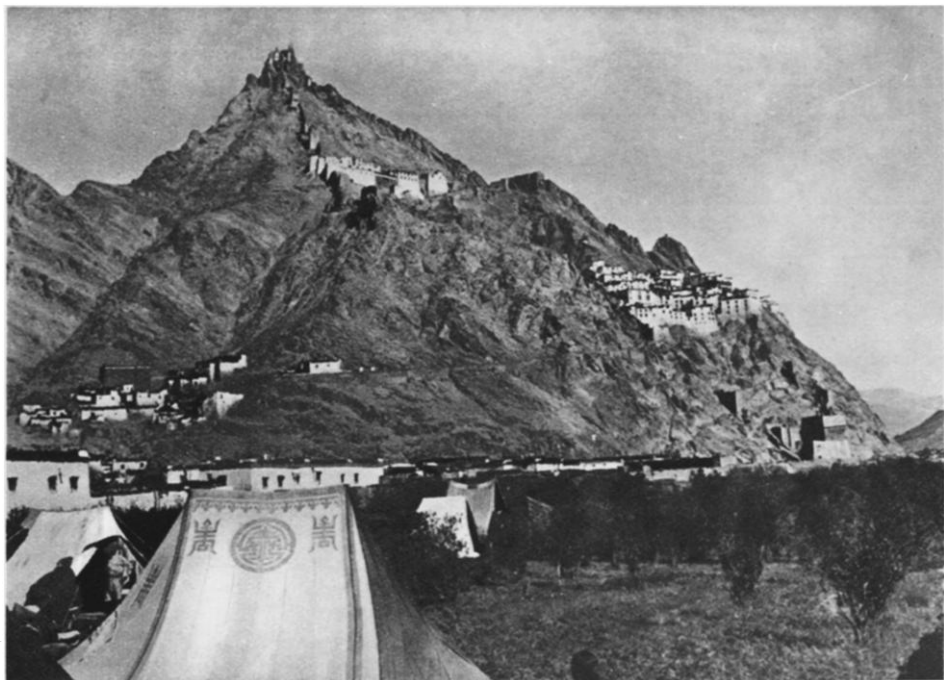




5. LOOKING EAST FROM 17,400 FEET ABOVE THE TINKI PASS



6. LOOKING E.S.E. OVER THE UPPER VALLEY OF THE ARUN FROM A HILL JUST NORTH OF THE ARUN-BHONG CHU JUNCTION



7. MESS TENT AND CAMP AT SHEKAR DZONG



8. TING-RI, THE FIRST BASE OF THE EXPEDITION



9. LOOKING SOUTH UP THE RONGBUK VALLEY TO MOUNT EVEREST  
FROM A HILL AT 17,000 FEET ABOVE ZAMBU



10. HOUSE AT LUMEH IN THE RONGBUK VALLEY

AH AG AF AA AB AD AO AP AQ AR AS

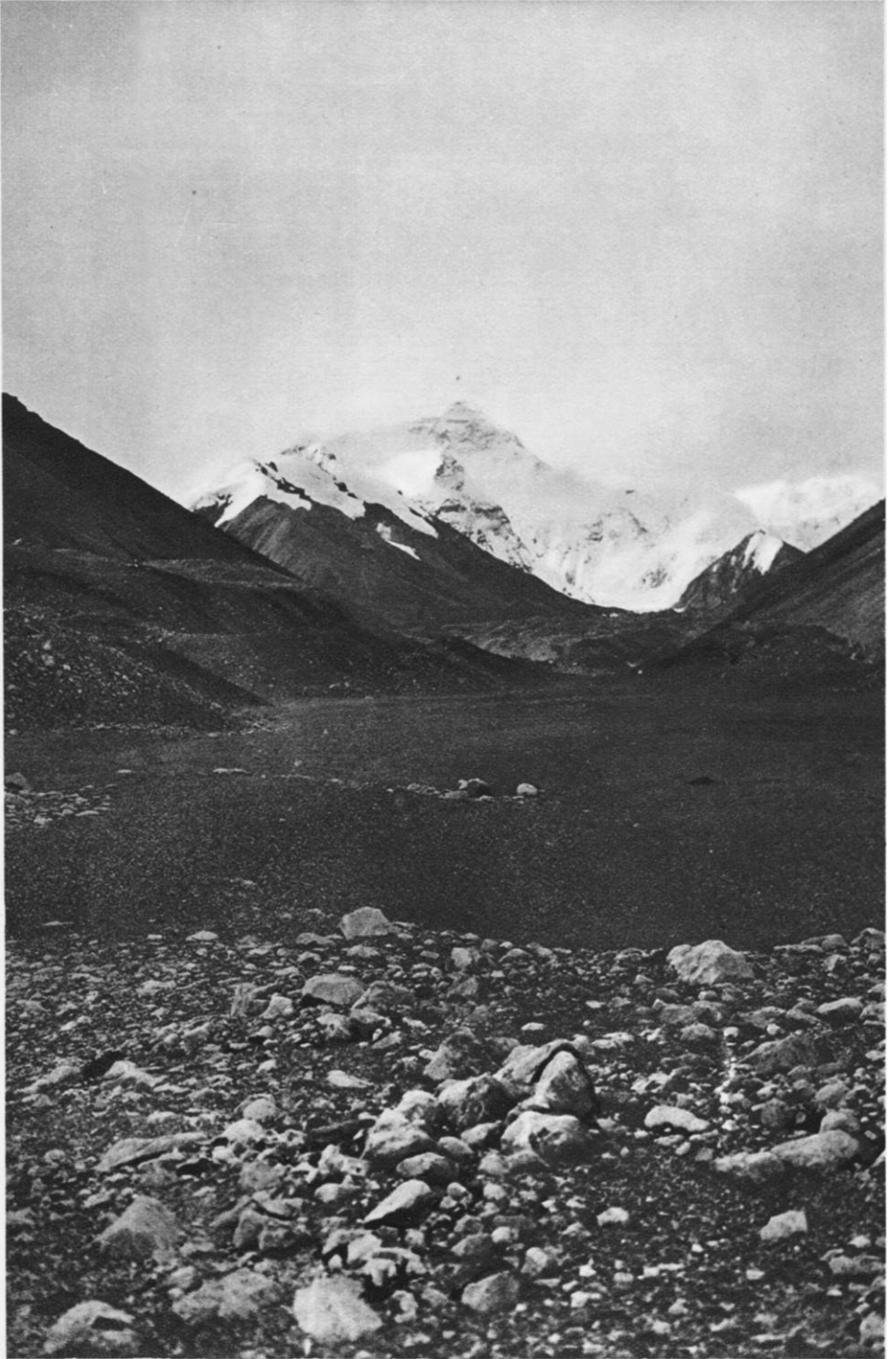


11. LOOKING SOUTH UP THE RONGBUK VALLEY FROM THE HILL AT 17,000 FEET ABOVE ZAMBU

AO AP AQ AS BA BB BD BC



12. LOOKING S.W. UP THE ADJOINING VALLEY TOWARDS PEAKS 25,990 AND 26,870

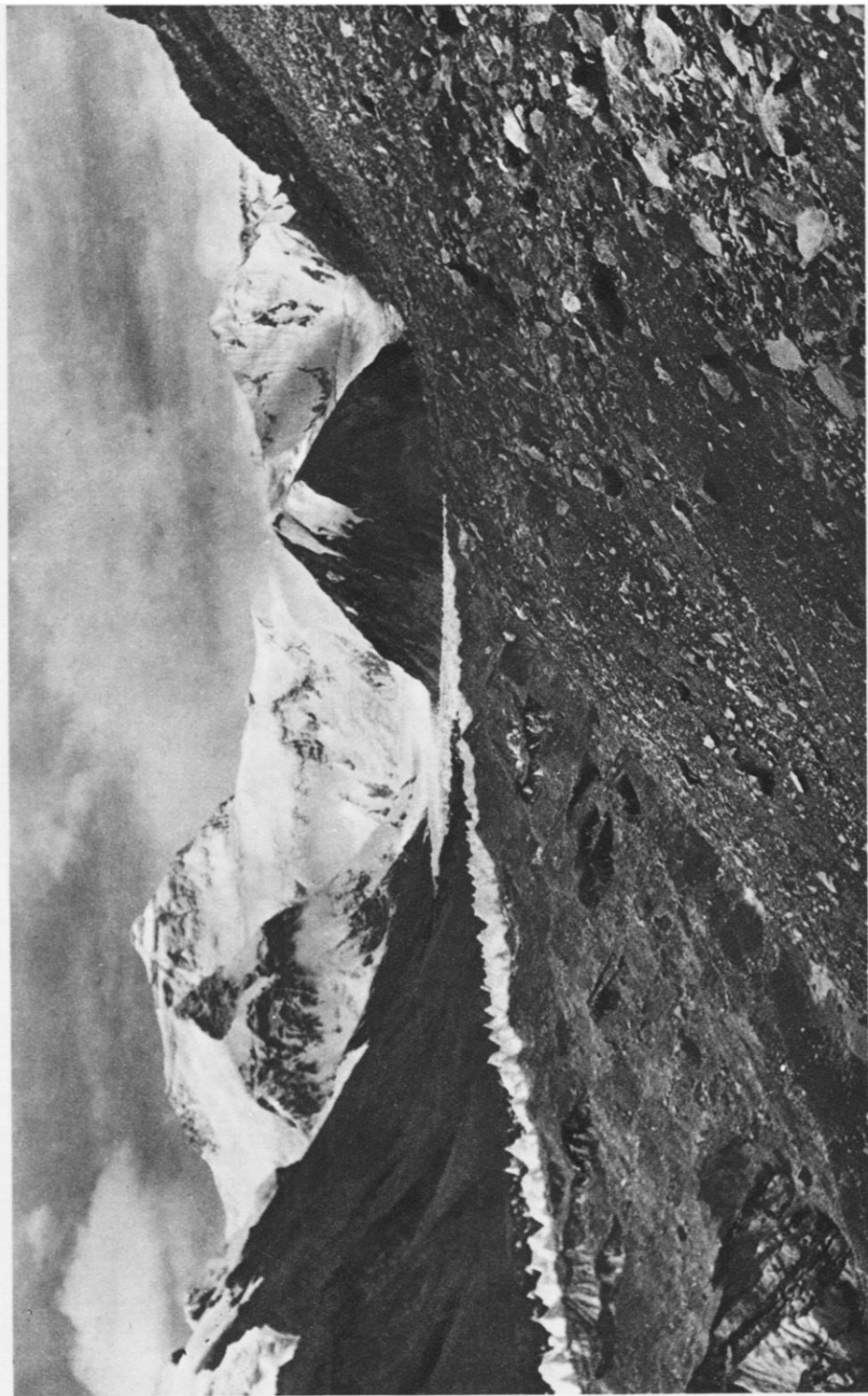


13. MOUNT EVEREST FROM BELOW THE SNOUT OF THE RONGBUK GLACIER

AA

AD AB

AE



14. MOUNT EVEREST AND THE RONGBUK GLACIER FROM ABOUT 19,000 FEET, NEAR THE ALPINE CAMP

BD BH BK BE BL BG BF



15. LOOKING S.E. FROM 17,700 FEET ACROSS THE KYETRAK VALLEY TOWARDS THE KHOMBU PEAKS AND PASS



BE  
BL

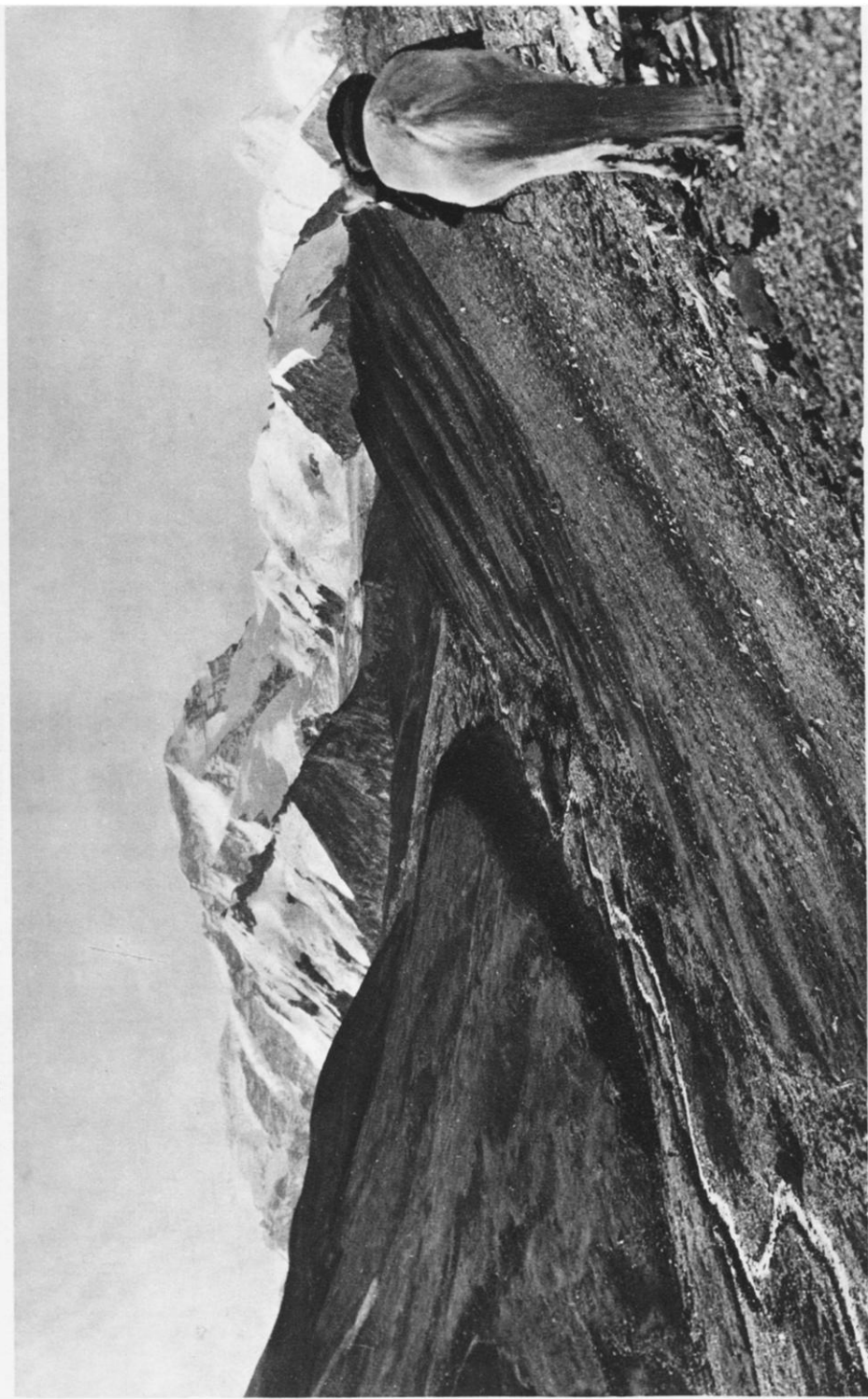
BK

BH

BD

BR

BC



16. A NEARER VIEW OF THE SAME PEAKS FROM THE MORaine OF THE KHOMBU GLACIER

BD

BK

BL

BE

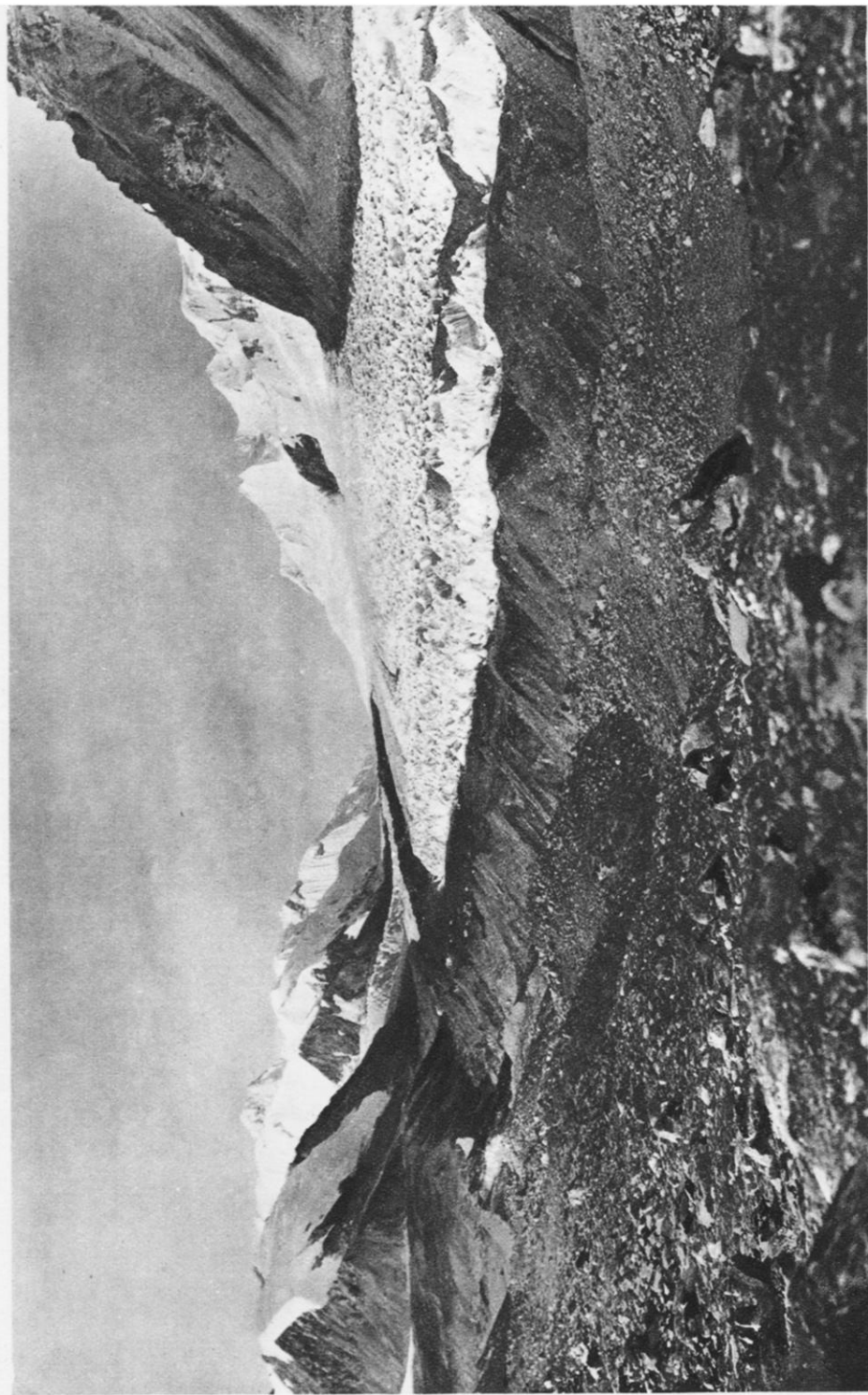
BG

BF



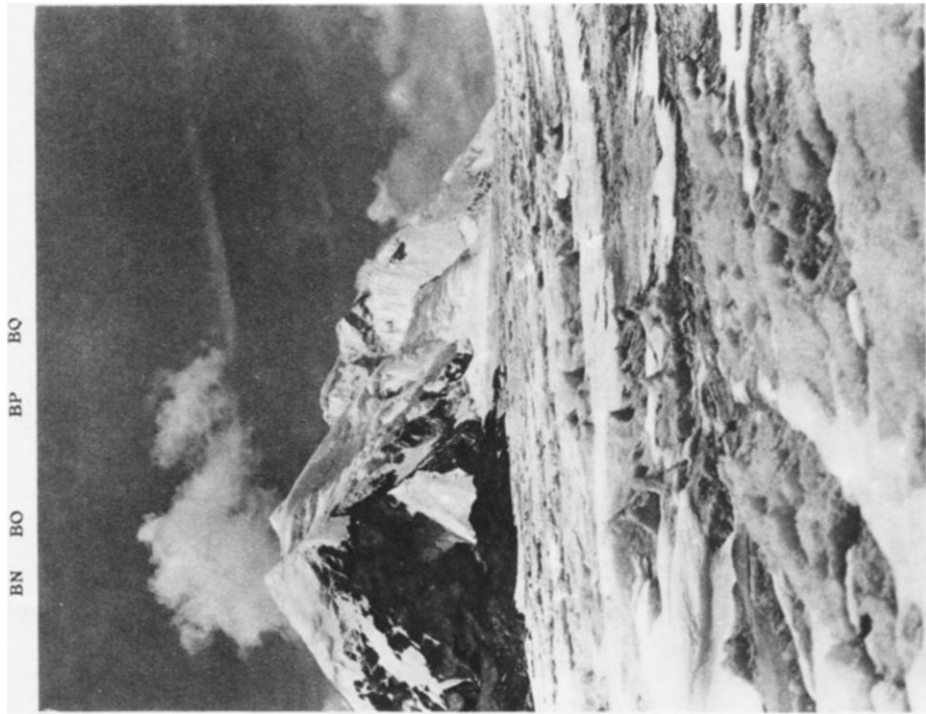
17. LOOKING UP THE KHOMBU GLACIER FROM THE TRACK LEADING TO THE PUSI PASS

BK BE BL BN BO BP BQ



18. LOOKING TOWARDS THE SUMMIT OF THE KHOMBU GLACIER FROM 17,700 FEET

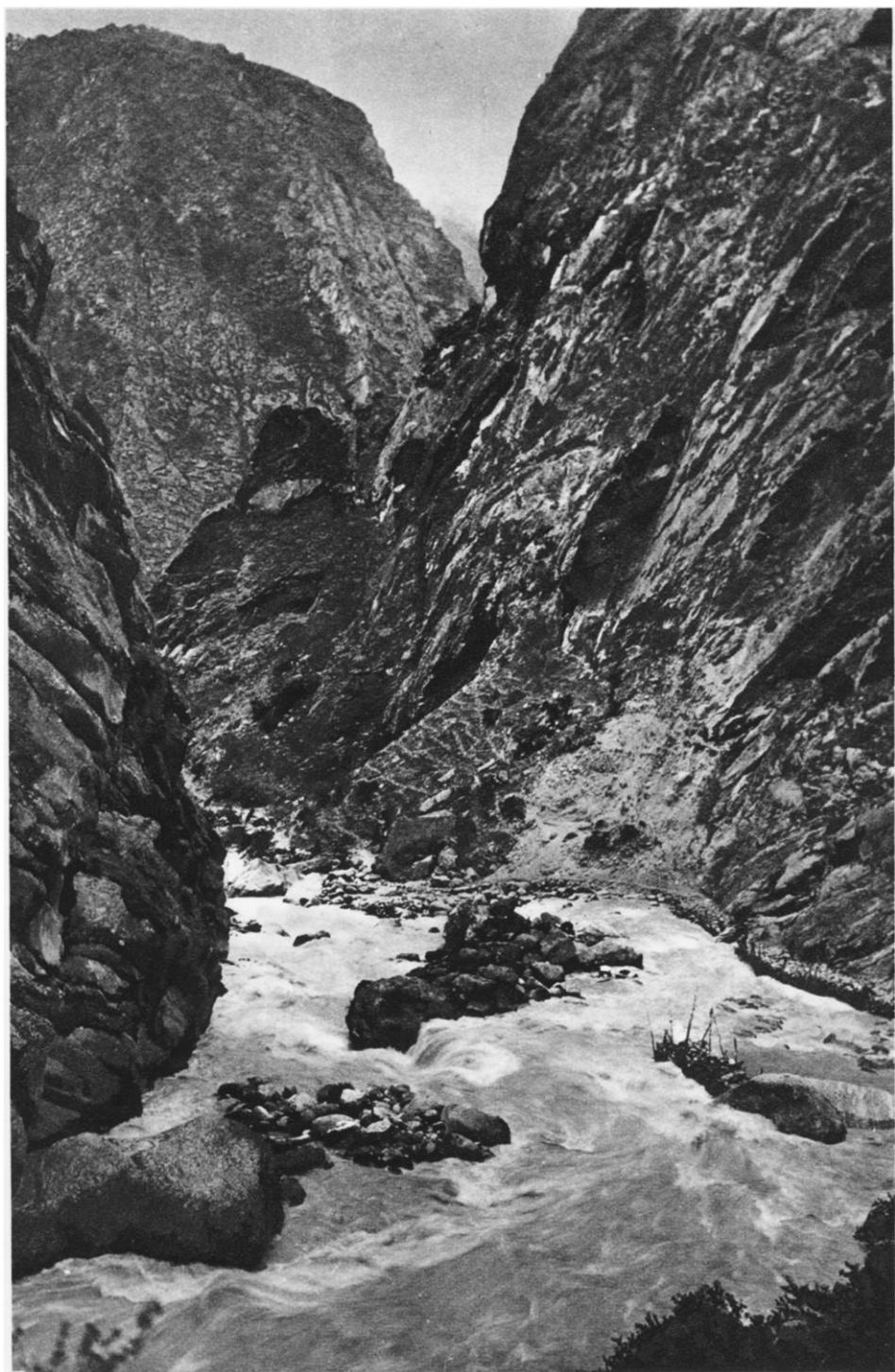
BN BO BP BQ



19. PEAKS EAST OF THE KHOMBU GLACIER  
NEAR THE HEAD OF THE PASS



20. CHOKABSANG  
WEST OF THE KHOMBU PASS



21. GNEISS GORGES IN THE RONGSHAHR VALLEY BELOW TAZANG ABOUT 12,500 FEET



22. PRIMULAS IN THE RONGSHAHR VALLEY AT 12,500 FEET

There is no difficulty in making out that it lies west of the pass, between it and the Pusi La ; but is it Peak T<sup>42</sup>, otherwise Peak 1/71 L (25,483) ? Probably yes : or what has become of it in photograph 15 ? But in that case the Khombu pass, which seems to be the old Pangu La, is further east than the map shows, and the summit of the pass further south, or there would be no room for a glacier 12 miles long, and no possibility of a glacier from BD joining it more or less at right angles, as shown in Plate 17. The Peak BE is so much displaced with reference to the others from different points of view that it must lie well to the south, and be very high ; but there is nothing corresponding to it on the Index Charts. The identification of the peaks up the eastern side of the pass, from one photograph to another, is quite easy from the characteristic shapes of the rock faces : there are in the collection two other photographs, one of an especially beautiful snow-peak, which may probably be on the western side, south of Chorabsang.

After a day or two on this glacier with Mr. Heron, Colonel Howard-Bury and he went over the Pusi pass into the Rongshahr valley, where are the lovely rock garden shown in our last photograph, and the splendid gorges of gneiss. The upper part of the valley is open and easy, with groves of juniper and willows, gardens of primulas and gooseberries ; but the gorges below are impracticable for transport, and hardly passable by coolies : whence, perhaps, the necessity for using the higher Khombu La for such trade as goes between Nepal and Tingri. The accepted boundary between Nepal and Tibet lies three marches down the Rongshahr valley from the pass, and the larger valley in which Nilam lies, to the west, is also Tibetan, for the Dzongpen invited Major Morshead and Mr. Wollaston to pay him a visit there, and they took the expedition's largest camera to photograph Gaurisankar and Gosainthan. In the Mount Everest country, as in many other places, the gorges some way down the valleys, and not the watershed, are the main topographical obstacles and the natural frontier.

From the Rongshahr valley Colonel Howard-Bury went to the Rongbuk, and thence to Kharta, to make arrangements for the change of base. He gives no indication of his route on this occasion, but he remarks that it was three long marches of over 20 miles from Rongbuk, and a long way from its place on the map ; and he got back to Tingri on July 11, riding 36 miles in the last day. The next few days were spent in developing the photographs which we now reproduce. Major Morshead and Mr. Wollaston left for Nilam on the 13th, rejoining on August 2 at Kharta. On July 24 the base camp left Tingri for Kharta, picking up Messrs. Bullock and Mallory at the mouth of the Rongbuk valley.

From this point we have no photographs to elucidate the description of the march in the telegram from Kharta dated August 4, and no letters from the expedition later than those dated July 19 had arrived at the time of writing (September 17). None of the names are on the Indian map, and

the only details of the route are these : From Chhöbuk the first march is to Rebu (apparently down the valley of the Rongbuk river), a picturesque village with good cultivation of barley and mustard, and splendid flowers. From Rebu is a long march of 21 miles over the Doya La (17,000 feet) to Chongpu, some miles beyond the pass. The next march gained the main valley of the Arun, still called the Bhong Chu, and 2 miles down this valley is the confluence of the Kharta Tsanpo, and apparently the position of the elusive Kharta, where at a height of only 12,300 feet a house and garden had been hired for the new base, high above the valley on a river terrace, in a grove of poplars and willows.

The records of the Survey of India must be made some day to reveal the information (doubtless from native sources) upon which Sheet 71 of the old 1/M series was compiled ; it was a sad exercise in imagination. Kharta is there shown 15 miles from the southern edge of the Sheet in a broad valley which might be the lower Rongbuk, on a track leading to the Popti La. Kharta proves to be something like 18 miles further south, probably on the next sheet, and the main stream of the Arun perhaps 10 miles further west than is shown ; \* or so we conclude from the cablegram dated Kharta, August 17, which mercifully came to hand much quicker than usual, to clear up the situation.

Colonel Howard-Bury there describes how, on August 4, he followed in the tracks of Messrs. Mallory and Bullock up the valley of the Kharta Tsanpo, through broad fields of barley, in a well-cultivated and populous valley. After 7 miles he turned up a side valley (evidently to the left), and the following day after a steep ascent gained the Langma La at 18,000 feet, † whence he looked down on the confluence of three glacier valleys, one from Makalu, one from Mount Everest, and the third from the north-eastern peaks. The Kangdoshang glacier, formed at the base of the tremendous northern cliffs of Makalu, sweeps right across the valley, and the glacier stream from the Kangshung glacier of Mount Everest passes under it in an ice cavern. The head of the valley, some 10 miles up, is filled by the semicircular cliffs of Mount Everest. Above the Rakbar glacier stream (apparently that from the peaks north-east of Mount Everest), and above the barrier of the Kandoshang glacier, are grassy pastures and yak-herdsmen. But the cliffs of the mountain are sheer black rock over which hanging glaciers discharge masses of ice all day long to feed the Kangshung glacier below.

The valley is perhaps the grandest in the world, but it does not offer a promising approach to the mountain. The mountaineers have therefore turned their attention to the upper valley of the Kharta Tsanpo, and are exploring its head, which is somewhere in the mass of high peaks north-

\* It is apparent from Dr. Kellas' photographs on the Kang La that the main gorge of the Arun runs much closer to the peak of Makalu than the map shows.

† This pass seems to be north, and the Kangdoshang glacier west of N 53, Pk. 1/72 M (25,413), which is so conspicuous on Dr. Kellas' photographs.



east of Mount Everest. There we must hope that they may have found some route less formidable than the others have shown themselves on first acquaintance.

The idea that the slopes of the mountain towards the Tibetan plateau might, as elsewhere, be much less steep than towards the south is evidently wrong; they could not be much steeper than they are. The difficulties are indeed formidable; but the "Fading Hopes" of the *Times*' poster on September 10 are not yet those of the Mount Everest Committee, still less of the expedition in the field, whose duty this year was to reconnoitre all the approaches to the mountain, but not to spend time early in the season on any one route until they had satisfied themselves that there was none easier that had been overlooked. Up to the present they have had no great temptation. But even if the north-eastern face should prove as forbidding as the others, the question will not be settled. A still stronger climbing party next year, with better fortune in health, will surely find some ridge or other of the mountain worthy of a grand assault.

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## THE CANADIAN ARCTIC EXPEDITION OF 1913 TO 1918

Vilhjalmur Stefansson, Commander

*Map following p. 320.*

WHILE I was engaged in the work of my polar expedition of 1908-1912, there gradually took shape in my mind the plans which we were able to carry out under the auspices of the Canadian Government during the years 1913-1918.

In the summer of 1853 Lieut. Meham said in his report to his commanding officer, Captain Kellett, that the exploratory journey which he had just finished to the west coast of Prince Patrick Island had been extended in length ten days by the ability of his party to secure game, and that he conceived it difficult to make such a journey successfully and without serious results to the health of the men engaged, without using fresh meat secured along the route to supplement any rations which were brought from the ship. The same year, in his report to the same superior officer, Captain Leopold McClintock made a similar statement at the end of a journey which Sir Clements Markham, in his 'Life of McClintock' (p. 166), has referred to as the greatest polar journey ever undertaken. McClintock as well as Meham places at ten days the extension of his journey beyond what would have been possible had no game been secured.

In Franklin's overland expedition of 1819 little game was secured, and there are few indications in his journal that there was any possibility

## THE MOUNT EVEREST EXPEDITION

A BRIEF telegram dated Phari Dzung, October 10, received in London on the evening of the same day, brought news that on September 22 six members of the expedition—Mallory, Bullock, and Wheeler only are named—with twenty-six coolies, arrived at the col at the head of the Kharta valley and camped at 22,500 feet. Next day the three climbers camped “on the glacier below the north col.” On the 24th they ascended the north col, between Mount Everest and the North Peak, to 23,000 feet, “finding the north-east arête quite possible”: but they were driven back by a furious north-westerly gale lasting four days, with intense cold, making all climbing impossible. The message ends “The reconnaissance of Mount Everest is now completed”; and we take this to mean that the expedition will now withdraw for the winter.

It is excellent news that the route discovered by Messrs. Mallory and Bullock some time in the middle of August has proved practicable. All through August the soft monsoon-snow made climbing very difficult, and prolonged effort impossible. After a rest at Kharta Messrs. Mallory and Bullock had started up again to the head of the Kharta Chu on August 31, to complete their preparations, hoping that the early days of September would see the end of the monsoon and give them several weeks of clear skies and hard snow before winter drove them down. This hope was falsified. We had when this was written on October 16 (but see note at end) no news of what happened between September 3, when Colonel Howard-Bury sent his last long cablegram, and September 22 when the greater part of the expedition arrived at the head of the Kharta valley; but it is evident that the weather must have been against them, or they would have been there earlier: and only two days later the gale set in which put an end to the enterprise for this year.

The withdrawal must have taken place on September 28 or 29, and Colonel Howard-Bury must have sent a runner to Phari with the telegram, whose date seems to be that of handing in at the telegraph office. It is hardly possible that the party had already reached Phari on their way home, only ten days after the storm had driven the climbers from their lofty camp.

When Mr. Raeburn reached Kharta on September 1 he reported that all the rivers to the north were in flood and bridges washed away. The bad weather in September may have prolonged the floods, rendering the passage of the Arun still difficult; and the Arun must be crossed, whether the return is made by the outward route of Phari and the Chumbi valley, or by the more direct and more difficult Tista valley. It will take some time to disband the party, sort out the stores, and settle up the accounts: so that the members who are returning to England will hardly arrive before the middle of December. They have, however, been warned that they are expected to give an account of themselves at a joint

meeting of this Society and the Alpine Club on December 20 at the Queen's Hall.

In the last number of the *Journal* we gave a sketch of the expedition's work up to about the middle of August, based on telegrams of which the last was dated August 17, and described the approach to Mount Everest from the east by the great valley of the Kama Chu, reached from the valley of the Kharta Chu (or Kharta Tsanpo) by a track over the Langma La. We have since received from Colonel Howard-Bury a magnificent series of photographs taken in this valley, to which we will shortly return. The later part of the telegram of August 17 describes his return to Kharta by another way "to the east of Makalu," down the valley of Shinchuthoungkar, to which a big glacier descends from between the "twin peaks of Makalu" (that is, we suppose, from between Makalu and N. 53: see later); thence up a side valley to the Shao La, and on to Sedhenthang (or perhaps passing the latter on the way to the former, for the terrace of Sedhenthang is still opposite the twin peaks); and returning to Kharta by the Shao La. None of these names are on any map; and it is not possible to fit this account to that of the next journey to be described, which was in the same district.

In a telegram dated Kharta, August 28, Colonel Howard-Bury describes a journey with Mr. Wollaston, made while the climbers were resting at Kharta for a few days before their final exploit. They crossed the Samju La (15,000 feet), to the Valley of the Fourteen Lakes, and thence by the Chog La and the holy lake of Roddamlamtso they came to Sakideng, on a terrace among juniper woods at 1000 feet above the valley of the Kama Chu "commanding fine views of Makalu only a few miles off," and therefore somewhere not very far from Sedhenthang. Six miles below Sakideng they crossed the Kama Chu by a bridge at 10,200 feet, and the following day went down to its confluence with the Arun, at only 7500 feet, the river falling nearly 500 feet per mile. Here the valley of the Arun opens out a little from its gorges to give space for a few villages (of which Lungdo is described as on a terrace at 12,000 feet), but soon closes in again between steep cliffs. The way to Nepal is by the frontier pass of the Popti La (14,000 feet), with an inscribed boundary stone and a wall. All these names are on the map just received from Major Morshead, to be described presently; but it is difficult to reconcile the narrative with the map, which shows the path down the Kama Chu and the village of Lungdo on the north of the Kama, while the narrative implies that it is south, and the Popti La not so far from the village as the map makes it. Perhaps the Shao La, by which Colonel Howard-Bury returned from the Kama Valley on his previous trip, opens on to the Valley of the Fourteen Lakes, from the west; at any rate, we can hardly doubt that it lies west of the route just described and east of the Langma La.

Month by month, indeed, our map-less condition has become more ludicrous. Two officers of the Survey of India, with several Indian

MB

MC

MD

EB EC ED

MT. EVEREST

ME  
↑  
front of MC



Kangdoshang Glacier

Kangshang Glaciers at head of main valley  
Rakbur Glacier in near valley

**I. VALLEY OF THE KAMA CHU, FROM BELOW THE LANGMA LA, AT ABOUT 16,000 FEET**

*Phot. by Colonel Howard-Bury.*

S.E. RIDGE

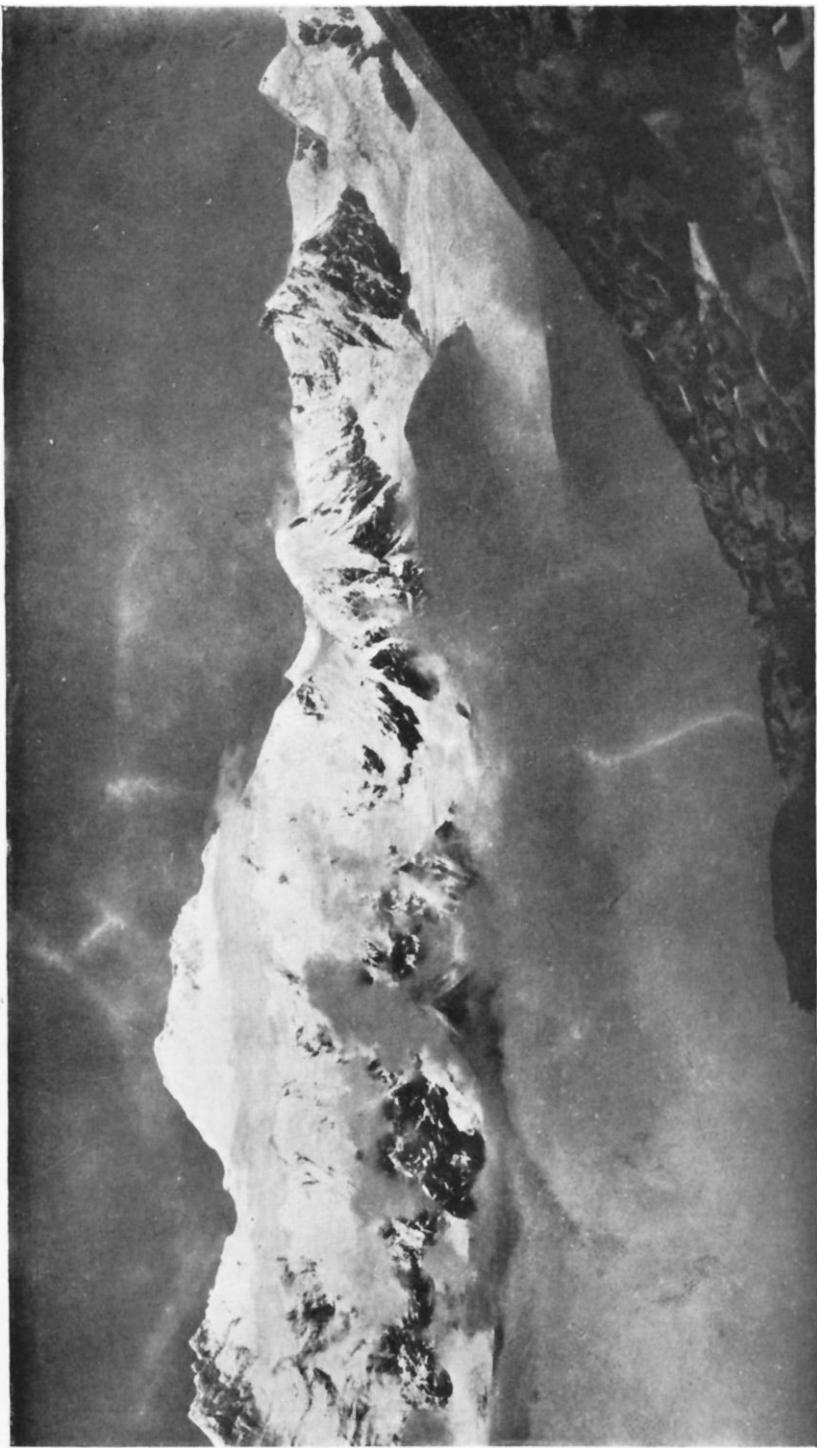
MT. EVEREST

EH

AA

EL

EM



II. MOUNT EVEREST FROM 19,600 FEET NEAR HEAD OF KAMA CHU

*Phot. by Colonel Howard-Bury.*

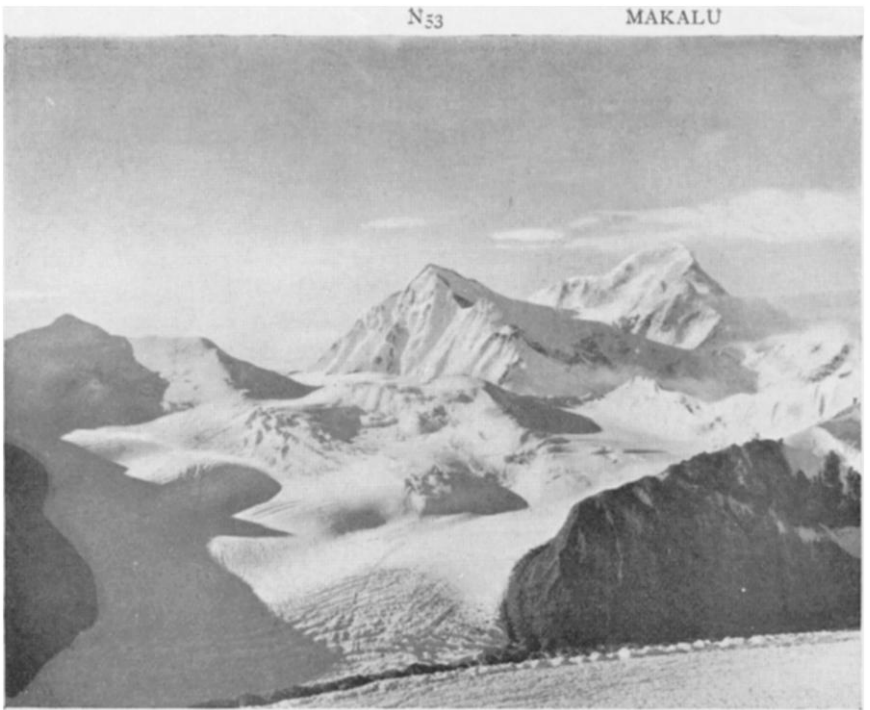
surveyors, have accompanied the expedition, and we learned some time ago that more than 10,000 square miles of country had been mapped. Under cover of a letter dated September 3 Major Morshead very kindly sent us a large tracing which raised high hopes. It extends from the Tinki pass westwards twice as far as Tingri, into country which we did not know had been visited by the expedition; it goes north beyond the position of the Tsanpo as shown on the India 1/M map (though the Tsanpo is not there); and it extends down the Arun river some way into Nepal. But around Mount Everest, from the Khombu glacier on the west through Zambu on the north, and round east of Kharta, is drawn a thick red line—the boundary of the country reserved for photographic survey by Captain Wheeler. Inside this boundary the tracing shows only a few details, sometimes contradicted by the evidence of the photographs, and doubtless only sketched in diagrammatically, not surveyed. There is no mention in any report of a plane-table being sent with the climbing party; there is not the slightest sketch of the head of the Kharta valley, to which we know Major Morshead himself accompanied Messrs. Mallory and Bullock. Apparently the photographic survey is considered all-sufficient in this area of the mountain, but it is not helpful for immediate needs; and the discussion which follows will show to what straits we are reduced.

From the summit of the Langma La (position unknown) one looks down into the Kama valley and across at the magnificent cliffs which are called in the telegrams the northern cliffs of Makalu. The photograph reproduced in Plate I. was taken from a point about 2000 feet below the pass. The first question is: If the mountain is Makalu, where is N53, 3 miles north-east by north of it? Long pondering over the photographs from many points of view, aided by the pictures taken by Dr. Kellas from the Kang La last December (*Journal*, April 1921, 57, 273), has led to the following conclusions, which are some of them very precarious: the three crests MB, MC, and MD all belong to N53, and none belong to Makalu proper, which lies 3 miles behind. The general line of the crests is evidently roughly parallel to the river. Careful measurements to well-defined points of the three show no relative displacement on photographs taken from points which must be at least half a mile apart; therefore the three are in a straight line. A peak seen over the shoulder of MB may be Makalu, but is probably not. The great cirque at the head of the Kama valley, Plate II., from EL to EM is clearly shown in Dr. Kellas' photographs, on which also one can pick out with less certainty the peaks EB and EC defining the great south-eastern arête of Mount Everest, and can see that the col between the north-eastern arête and EL is even lower and steeper than it looks on Plate II. This must not be confused with the col to the North Peak, across which lies the route to the summit.

We now come to a great puzzle. Where is the peak lettered C on Dr. Kellas' photograph, which was seen also by Mr. Freshfield and

photographed by Signor Sella from the Chunjerma La? By the contrast in the detail one would judge it nearer than Mount Everest and only a little beyond N53. By methods which he did not explain, Dr. Kellas placed it several miles north-east of Mount Everest; yet it is nowhere to be found on the photographs, apparently covering the whole ground, which we have now received from the expedition. It stands too high above the minor peaks north of it to be the "North Peak," and is not the right shape. It is much too clearly separated from N53 to be the pinnacle ME which stands out a little from the face of MC. It is too far north to be a beautiful isolated peak EA on the sweep between the south-eastern arête and N53 (hidden in Plate II.). And it looks much too near to be the fine peak of about 24,000 feet photographed by Captain Wheeler away to the west of Mount Everest, south of the West Rongbuk glacier. It can scarcely have fallen down since last December; it ought to be conspicuous in our photographs; yet long consideration of every suggested identification has seemed to give conclusive arguments against it. In this absurd position we are left by the absence of any sketch-map of the dozens of peaks in the complicated field of the expedition.

When such an apparently obvious problem defies solution, though the photographs which ought to solve it are extensive and of very high quality, one may expect more trouble still in following the route by which the climbers eventually reached the north-eastern arête. In his telegram dated Kharta, September 3, Colonel Howard-Bury says that Messrs. Mallory and Bullock, with Major Morshead, ascended in August the Kharta Valley glacier in deep snow "until they reached a col nearly 23,000 feet, looking on to the northern ridge of Everest about a mile farther on across another glacier," and said that it was possible to reach the ridge this way. But what glacier is this? When the climbers found the way, they did not know. In an extract from a letter kindly communicated by Mrs. Mallory, her husband writes: "There sure enough was the suspected glacier running north from the cwm under the north-east face of Everest. How we wished it had been possible to follow it down and find out the secret of its exit. There we were baffled. But the head of this glacier was only a little way below us, perhaps 700 feet at most, and across it lay our way, across easy snow up into the other side of the cwm, where the approach to the north col, the long wished-for goal, could not be difficult nor even long." Evidently the bad weather and what they describe as "scorching mist, more burning than bright sunshine, and intolerably breathless," was responsible for the failure to recognize the glacier as an eastern affluent of the Rongbuk. In a note on a panoramic photograph taken by Captain Wheeler he says, "the north ridge of Everest . . . divides the Main and the East Rongbuk glaciers; the climb will be attempted at the head of the East Rongbuk Glacier to the col and ridge joining Everest to its North Peak." And in the telegram from Kharta of September 3, Colonel Howard-Bury, summing up the Rongbuk



III. N53 AND MAKALU FROM 20,500 FEET AT HEAD OF KHARTA VALLEY

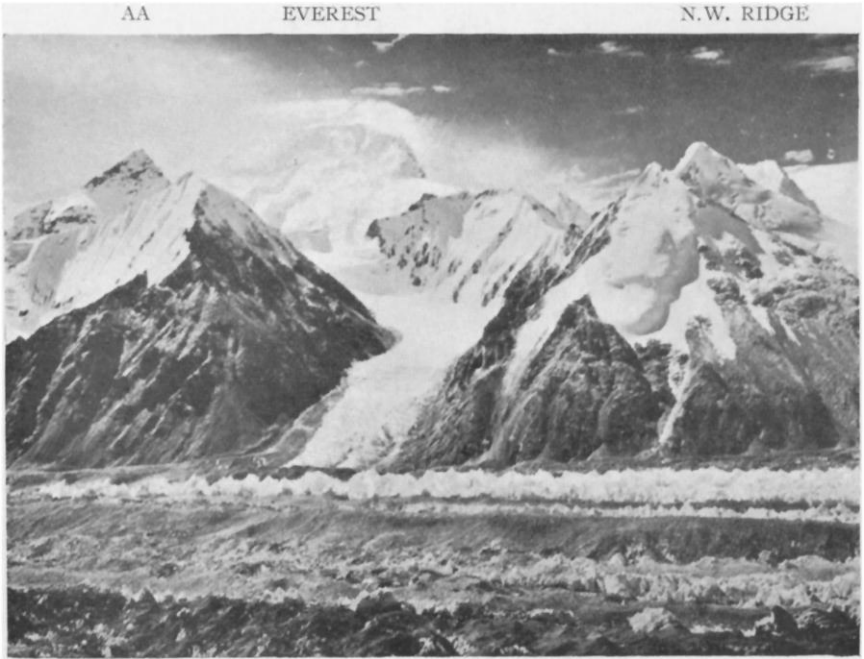
*Phot. by G. L. Mallory.*



IV. VIEW OF PEAK 20,500 FEET AT HEAD OF KHARTA VALLEY, SHOWING LINE OF APPROACH BY COL LEFT OF AA (NORTH PEAK) AND NORTHERN BRANCH OF NORTH-EAST ARÊTE

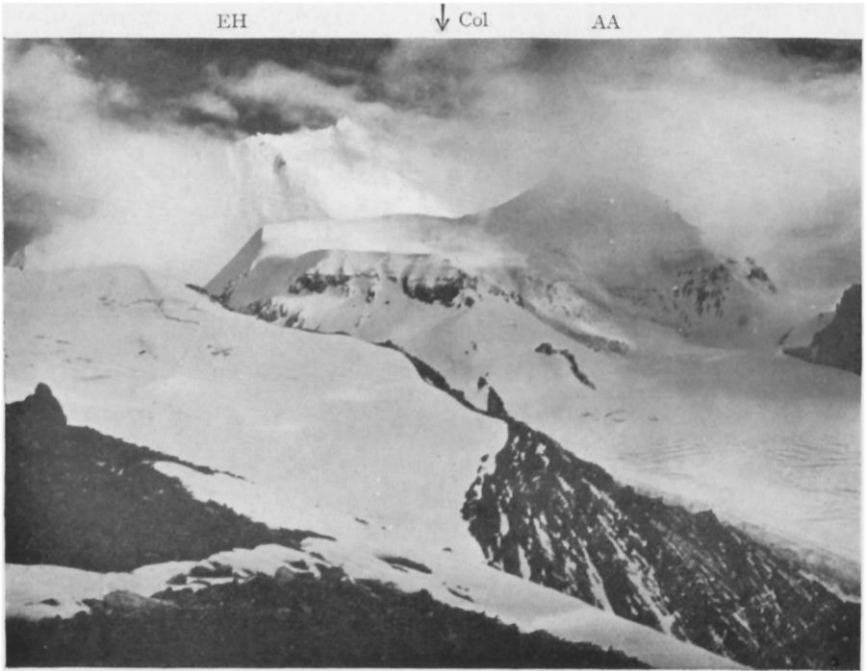
*Phot. by G. L. Mallory.*





V. NORTH PEAK AND NORTH-WEST RIDGE OF MOUNT EVEREST, FROM ABOVE THE WEST RONGBUK GLACIER

*Phot. by Capt. Wheeler.*



VI. LOOKING ACROSS THE EASTERN SHOULDER OF NORTH PEAK (AA) TO THE NORTH-EAST ARÊTE ; THE 23,000-FOOT COL IS BEYOND THE SHOULDER

*Phot. by Capt. Wheeler.*

reconnaissance, says, "The approach up the eastern branch of the Rongbuk glacier to the col to the north of Everest appeared a practicable but very long proceeding; but before it was possible to make any serious attempt to penetrate this valley the weather broke."

The significance of this passage is now evident. Captain Wheeler's photograph makes it possible to conclude that the East Rongbuk is not one of the many affluents of the main glacier at the head of the valley, but a quite separate glacier roughly parallel, on the other side of the North Ridge which forms the eastern boundary of the upper valley. Its exit may be seen in Plate 13, October *Journal*, on the near side of the peak lettered AC, close to the snout of the main glacier, and well below the Alpine Camp whence Mallory and Bullock were reconnoitring. The importance of this side valley might easily escape notice at first, especially if the east glacier itself does not come down to the exit, and only a glacier stream reaches the main valley.

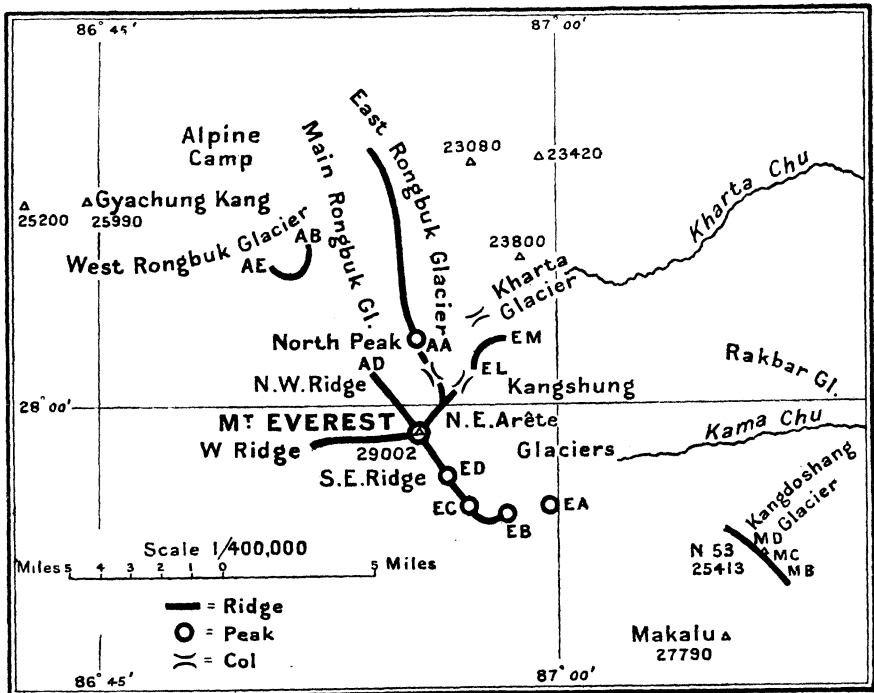
In planning the grand assault next year the critical question will be whether to gain the head of the East Rongbuk glacier by way of the Kharta valley, as they have done this year, or by the more natural but untried route straight up the glacier from the Rongbuk valley. The former involves a climb up the difficult Kharta glacier to 23,000 feet, and a descent of 700 to 1000 feet, which it would be desirable to avoid. Moreover, if it remains true, as was suggested in an early report, that the only way to reach Kharta early in the season is to go round by Tingri, there would be a double reason for preferring the much shorter way opening out of the easy Rongbuk valley. The Committee will await with great interest the information which Captain Wheeler must have on these matters, for it is evident from his photographs that he has been working on the northern ridge between the parallel glaciers.

One of these photographs reveals for the first time the great extent of the west glacier that joins the main Rongbuk glacier in front of the black pyramid AB in Plate 14, October *Journal*. This glacier comes straight along the south of the line of peaks shown in Plate 12. Its head is reported to be an unused glacier pass 19,000 feet high, leading to Nepal. This head, moreover, cannot be very far from the Khumbu pass, reconnoitred by Colonel Howard-Bury early in the season. But we must suppose the two distinct, for the reconnaissance was directed to finding a glacier descending from Mount Everest to the Khumbu, and could hardly have missed a glacier going the other way. All this region is included within the red line, and therefore not shown on Major Morshead's map.

The rough diagram here produced to illustrate the reconnaissance follows the lines of that given last month; we are reasonably sure that the places are in the right order, but unable to place them more definitely. To derive anything more than vague generalities from a photograph one must have the trigonometrical positions of three recognizable points, and the focal length of the camera. No photograph we have yet received

shows more than two known points, and even these are doubtful. We do not know, for example, which of the three summits of N 53 is Peak 1/72M, nor if EC is rightly identified as Peak 38/72I.

We have, therefore, for the time being no possible means of converting the photographs into a sketch-map; and many questions of the highest interest must be left open. Among them is the nature of the col connecting Mount Everest with the north peak. The northern face of the mountain seems to be pretty nearly a plane triangle, of which the north-east and north-west arêtes form the sides. The col at the end of the former, above the Kama Chu glaciers, is impracticable; that con-



Rough diagram to illustrate the proposed route to the North-eastern Arête of Mount Everest.

necting with the north peak cannot be seen in any photographs that have yet reached us. It must, we think, be right behind the north peak AA on photograph 14, and from the descriptions it leads to the north-east arête rather than to the north face. Presumably therefore the col in Plate II. and the col which is to form the route run almost together at the foot of the north-east arête—or the arête divides to form the two cols—and the source of the East Rongbuk glacier lies between them. Photograph VI. by Captain Wheeler suggests that the arête forks at EH, and that the East Rongbuk glacier descends in the valley from left to right across this picture; and on the whole it seems probable that the face seen obliquely

in Plate II. is not the whole north face of the mountain, but a secondary face between the two branches of the north-east arête.

The slight topographical obscurity in which the expedition remains involved is the only obstruction to our full appreciation of their excellent work in this first season. The climbing party, deprived of the great experience of Dr. Kellas and the leadership of Mr. Raeburn, have made up by courage and enterprise for their initial disabilities, and have at the end of the season been reinforced by the strength of Major Morshead and Captain Wheeler. Mr. Wollaston, after the tragedy of Dr. Kellas' sudden death, the illness of Mr. Raeburn, and some early sickness among the coolies, has had no further anxiety, and with all the party in good health, has had full leisure for his work as naturalist. Colonel Howard-Bury has not only commanded the party with conspicuous success, but has himself done the great part of the admirable photography, and has made several interesting journeys of exploration, and written the charming reports cabled to the *Times*. From their first meeting after the recess the Mount Everest Committee cabled to him their warm congratulations, expressed their high appreciation of his skilful leadership, and of the enterprise shown by Messrs. Mallory and Bullock, and asked him to convey the thanks of the Committee to all ranks in the party.

*Note added October 21.*—Later cablegrams published just as we go to press give further details of the final climb of the season. Persistent bad weather attended the party from the time they left Kharta early in September. The three who camped at 22,500 feet on the Lhakpa La (Windy Pass) with the climbers were Colonel Howard-Bury, Mr. Wollaston, and Major Morshead. Mr. Raeburn had remained at the 20,000-foot camp. The climbing party were accompanied to the north col by three unladen coolies. The route was sometimes exceedingly steep, but quite practicable. On the col they met whirlwinds of suffocating snow and an icy north-westerly gale, while above them the whole face of Mount Everest was "smoking" with driven snow. The slopes appeared quite passable in fine weather, but in such a gale nothing could be done, and the party reluctantly withdrew. Colonel Howard-Bury, Mr. Wollaston, and Captain Wheeler returned by the Kama valley, and the former got across to a col between Mount Everest and N53 at 21,500, whence the southern face of the mountain could be seen, very steep and unpromising.

Headquarters left Kharta on October 5, and all the party are expected in Darjeeling before the end of the month.

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of Chad is the river Libet, which is full of fish and supports a fish-drying industry of considerable importance. Though 700 miles from the sea, this spot is frequented by large numbers of grey-headed gulls (*Larus cirrhocephalus*). It is not clear whether these birds nest in the neighbourhood or are only migratory. A brisk trade in natron is carried on between French and British territory across Lake Chad. The natron is prepared in blocks weighing about forty-eight pounds each, from alkaline deposits in French territory. It is transported across the lake on rafts of reeds which serve the purpose of canoes. The life of one of these canoe-rafts is said to be less than a month. After this they become sodden and are no longer buoyant. When new, a large raft of this description will carry two tons or more of natron. These blocks of natron (consisting of a mixture of sodium carbonate and sodium bicarbonate) are worth one shilling each at Chad, but are sold at fifteen shillings in distant parts of Nigeria owing to the high cost of transport. Stock-owners throughout the country use this natron in place of rock-salt for cattle.

Though Chad is at present far removed from railway communication, it is none the less an important trading centre for native merchandise. Several schemes have been suggested by the French as well as by ourselves for linking it up by rail with the outside world, and when one of these eventuates the results are likely to surprise those not familiar with the great potentialities of these regions.

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## THE MOUNT EVEREST EXPEDITION

**A**T the meeting of the Society on Monday, November 7, the President made the following statement :

The Mount Everest Expedition of the present year has accomplished its object. After persistently probing round the mountain in many different directions, Messrs. Mallory and Bullock have succeeded in reaching a point on one of its buttress ridges from which the way to the summit seems reasonably practicable. This point is on the north-eastern arête, and is some 6000 feet below the summit. The climbers are satisfied that from there the summit may be reached without meeting any insuperable difficulty from the actual configuration of the mountain.

In addition to this main result, the Indian Survey Officers, Major Morshead and Captain Wheeler, have surveyed 13,000 square miles, mostly of unknown country, and have made a detailed photographic survey of the whole Everest group. Mr. Wollaston has made valuable and interesting collections of the plants, birds, animals, and insects. Dr. Heron has made a geological survey of the region between Mount Everest and the Brahmaputra. And Colonel Howard-

Bury has sent home a series of despatches and photographs which reveals to the world combined mountain and forest beauty of a grandeur nowhere surpassed, and which from now onward will be available for the perpetual enjoyment of mankind.

All this has been accomplished at a cost—excluding what the Government of India may have expended in Survey—of about £5000.

For these satisfactory results we are mainly indebted to the fine leadership of Colonel Howard-Bury. But about that and about the conduct of the other members of the Expedition I shall have more to say when we welcome them back in the Queen's Hall on December 20. I wish, however, on behalf of the Royal Geographical Society and the Alpine Club here at once to acknowledge with great gratitude the support the Expedition has received both from the Government of India and from the Tibetan authorities. Lord Chelmsford, Lord Reading, Lord Rawlinson, and Lord Ronaldshay have all lent the Expedition their keenest support; and from Colonel Ryder, the Surveyor-General, and from Mr. Bell at Lhasa they have received the greatest assistance. Most satisfactory of all, the Tibetan officials and people have thoroughly been friendly and helpful, and Colonel Howard-Bury in his final dispatch says that the Tibetans were quite sorry the Expedition was leaving.

All this is well enough. But it is only the first step. The real tussle is to come. We have ascertained that there is a way up. But we have now to find men who can, when exhausted by the increasing rarity of the atmosphere, stand the terrific blizzards and the frightful cold which they will encounter on those crucial 2 miles of knife-edge ridge. Endurance and determination in the extreme will be required. But all we can do by careful staff-work and by making use of all the experience available to help the climbers we will do.

We shall have to reorganize the Expedition for its final object and find a new leader, for Colonel Howard-Bury has been away for two successive years and his home in Ireland needs his attention. Besides the chief of the Expedition, we shall want six men for the climbing party. And we are advised that May and June are the best months for climbing Everest, so the Expedition will have to leave Darjeeling about March 21. Some members of this year's expedition will, we hope, be able to go out again, and we are gratified to hear that most of those Himalayan coolies who were specially enlisted for this year's work have already volunteered to join next year's party.

The Chairmanship of the Mount Everest Committee should now have devolved upon the President of the Alpine Club. But Prof. Norman Collie and the other members of the Committee have been good enough to invite me to retain the Chairmanship in view of my special knowledge of local conditions. I take this opportunity of

acknowledging their great courtesy and kindness, and of assuring both the Alpine Club and this Society that I will do all in my power to assist in the successful achievement of the great object we all have before us.

At the Meeting on November 21 the President announced that Brig.-General the Hon. C. G. Bruce had been appointed to lead the second expedition.

The photographs of the Kama valley and country east of Mount Everest did not arrive in time to allow preparation of more than a few half-tone blocks to illustrate the narrative of the expedition compiled from cablegrams for the November *Journal*. But in the present number we are able to give a further series of photogravures from the rich collection of pictures made by Colonel Howard-Bury and other photographers of the party; and a wonderful batch of negatives that arrived by the Indian mail of November 7 will require another.

The great difference between the country east and west of the mountain is well shown in the panorama made by Captain Wheeler (No. 10) from the southern slopes of peak 25,990, looking across the long West Rongbuk glacier that comes down from a glacier pass of 19,000 feet on the Nepal border somewhere east of the Khumbu pass. The valleys here are high and glacier filled; the principal faces of the mountain are great triangular planes of rock, singularly alike in their structure and disposition: compare the north face of Mount Everest, the west face of the North Peak AA, and the gable ends of the north-western (AD) and western ridges. This arrangement of triangular faces is continued in the great inclined plane between the two branches of the north-east arête, and repeated on a smaller scale in the facet cutting off the eastern branch above the col overlooking the Kama valley. The eastern face (No. 8) and the long south-eastern ridge ending in the great cirque (No. 7) are less severe in their beauty, though quite as formidable to the climber. Not the slightest hint of Dr. Heron's geological results has reached us, and it is not known whether he has been able to get at the lower slopes of the mountain itself.

The East Rongbuk glacier, which has played so elusive a part, lies behind the ridge on the left of Captain Wheeler's panorama, more or less parallel to the Main, and at right angles to the West Rongbuk. It seems to be so completely separate from the other two that it deserves a separate name, worthy of its importance in the problem. Further reflection and study of the photographs just arrived confirm the opinion expressed last month, that the critical question for next year is to decide whether to gain the head of this glacier by the known route of the Kharta valley and over the Lhakpa La, or to try first the straightforward ascent from the Rongbuk valley that was unfortunately never attempted this year owing to the break of the monsoon in early July.



**1. LOOKING NORTH UP THE ARUN VALLEY FROM ABOVE BASE CAMP AT KHARTA**



**2. HOUSE AND CAMP AT KHARTA: THE SECOND BASE OF THE EXPEDITION**

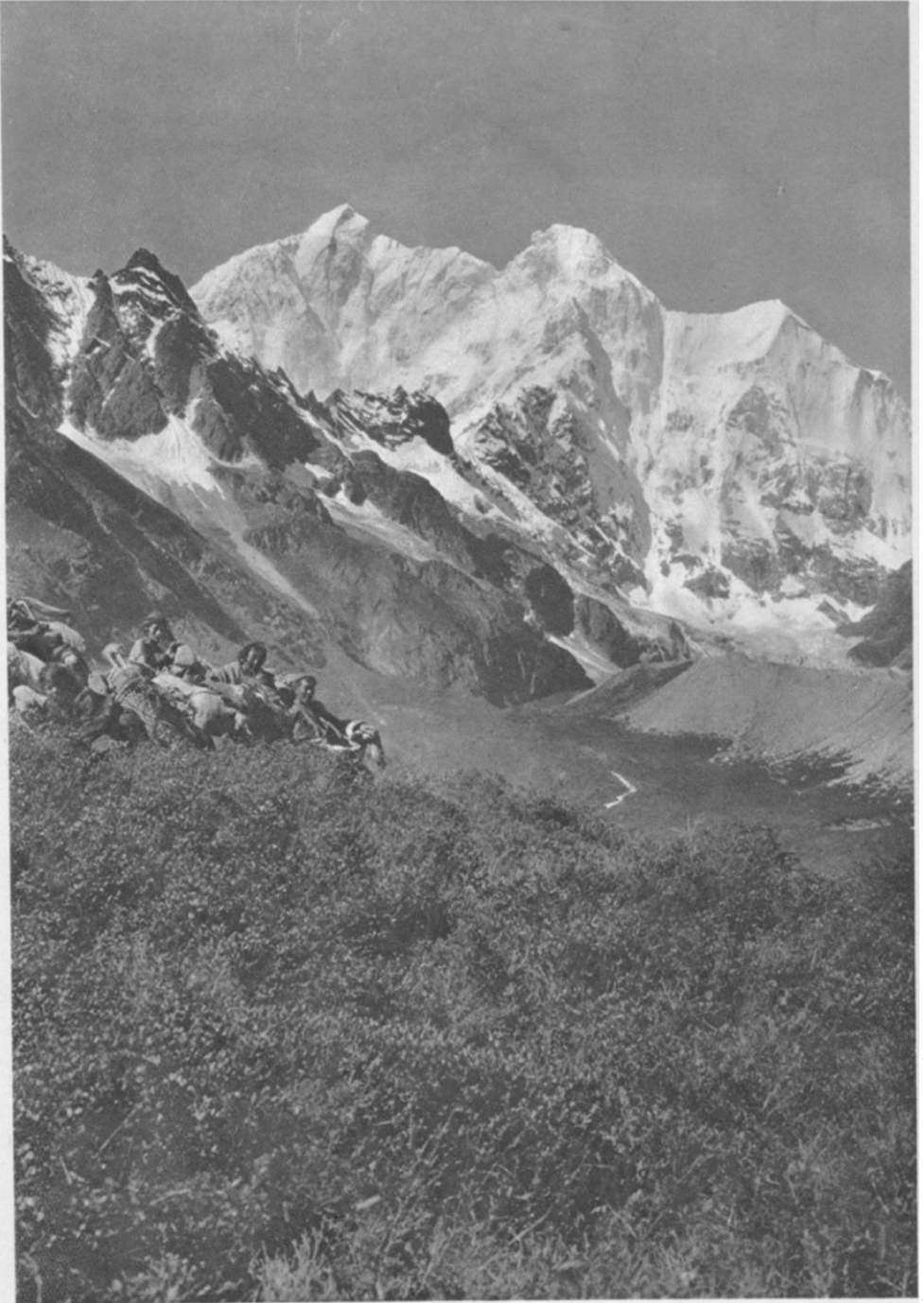
*Phot. by Col. Howard-Bury, D.S.O.*



MB

MC

MD



3. THE CLIFFS OF N53 FROM PETHANG, VALLEY OF THE KAMA CHU, AT 14,500  
FEET

*Phot. by Col. Howard-Bury, D.S.O.*



4. THE GLACIER CAVERN BY WHICH THE KAMA CHU PASSES UNDER THE  
KANGDOSHANG GLACIER BELOW THE CLIFFS OF N 53

*Phot. by Col. Howard-Bury, D.S.O.*



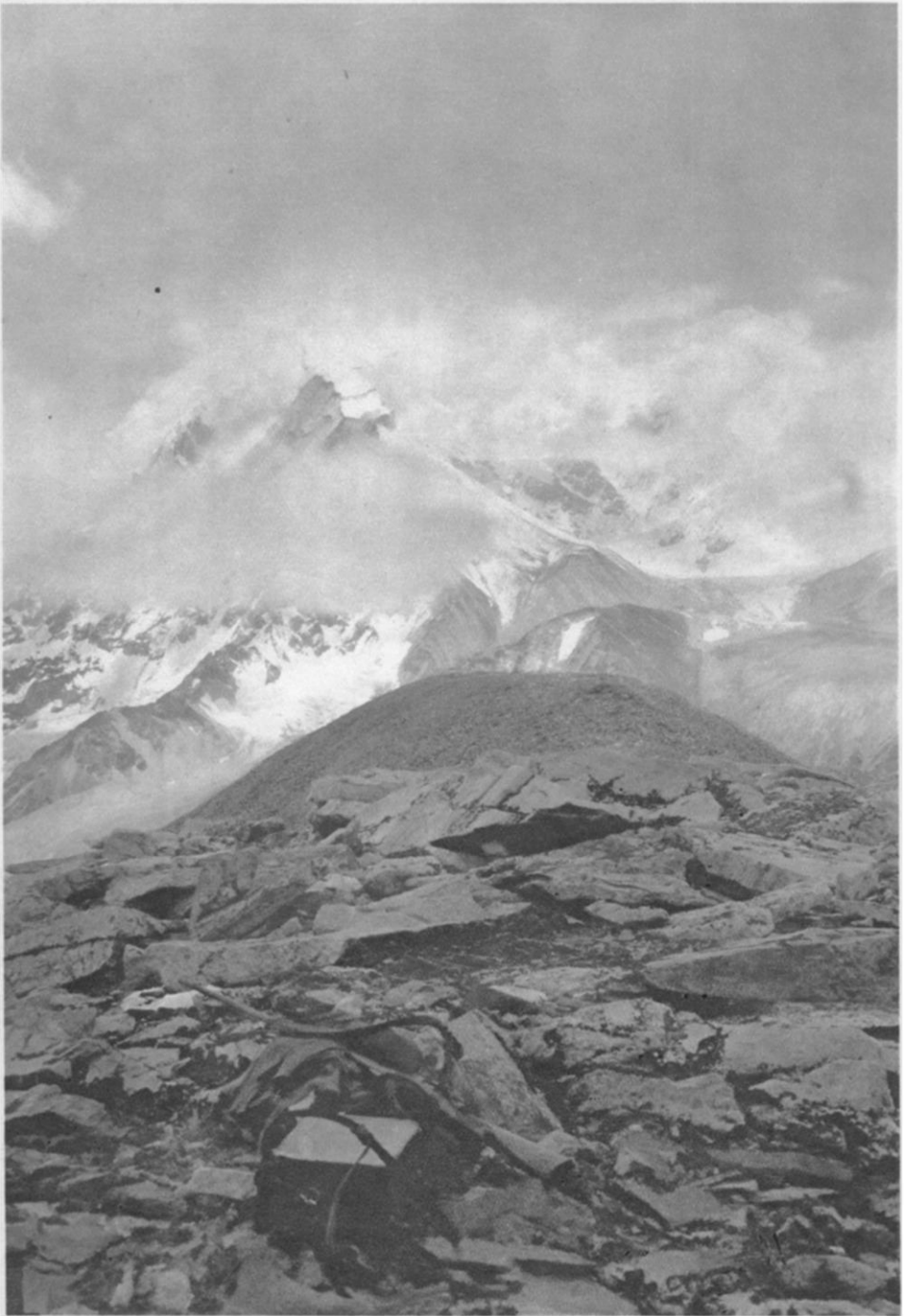
5. THE CAMP AT PETHANG RINGMO AT 16,400 FEET IN THE KAMA VALLEY  
BELOW THE CLIFFS OF N53

*Phot. by Col. Howard-Bury, D.S.O.*

ME

MD

Makalu



6. THE SUMMIT OF MAKALU AND THE CLIFFS OF N 53 FROM 19,600 FEET NEAR  
THE HEAD OF THE KAMA VALLEY

*Phot. by Col. Howard-Bury, D.S.O.*

EB EC ED EE



7. THE CIRQUE AT THE END OF THE SOUTH EAST RIDGE OF MOUNT EVEREST FROM ABOUT 20,500 FEET

The snow peak in foreground climbed by Mallory and Bullock on August 7th

Phot. by G. L. Mallory

8. TELEPHOTOGRAPH OF THE EASTERN FACE OF MOUNT EVEREST AT HEAD OF KAMA VALLEY

Phot. by G. L. Mallory

EC ED EE Summit EG

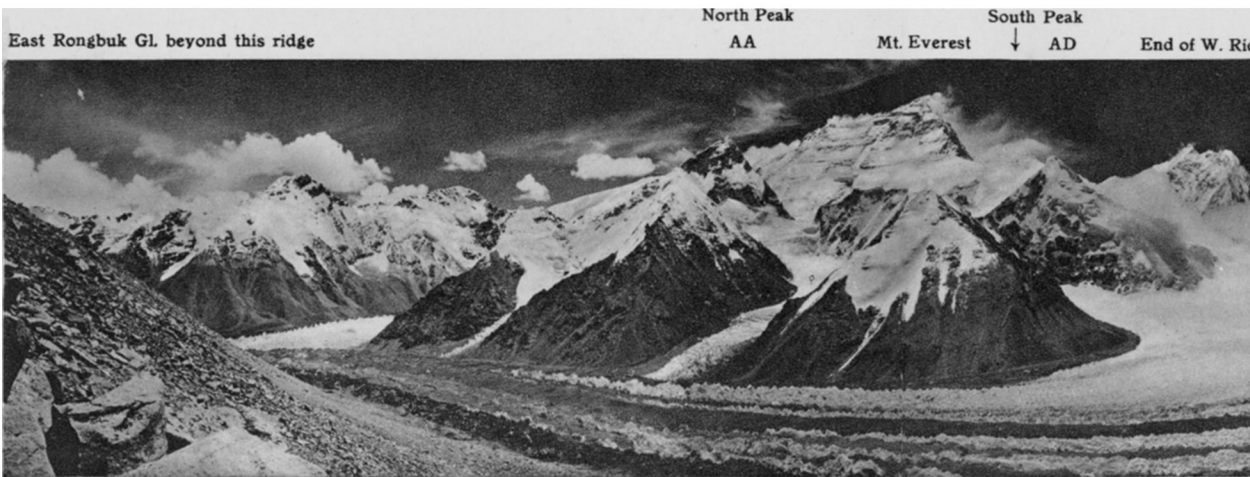


N 53 Makalu

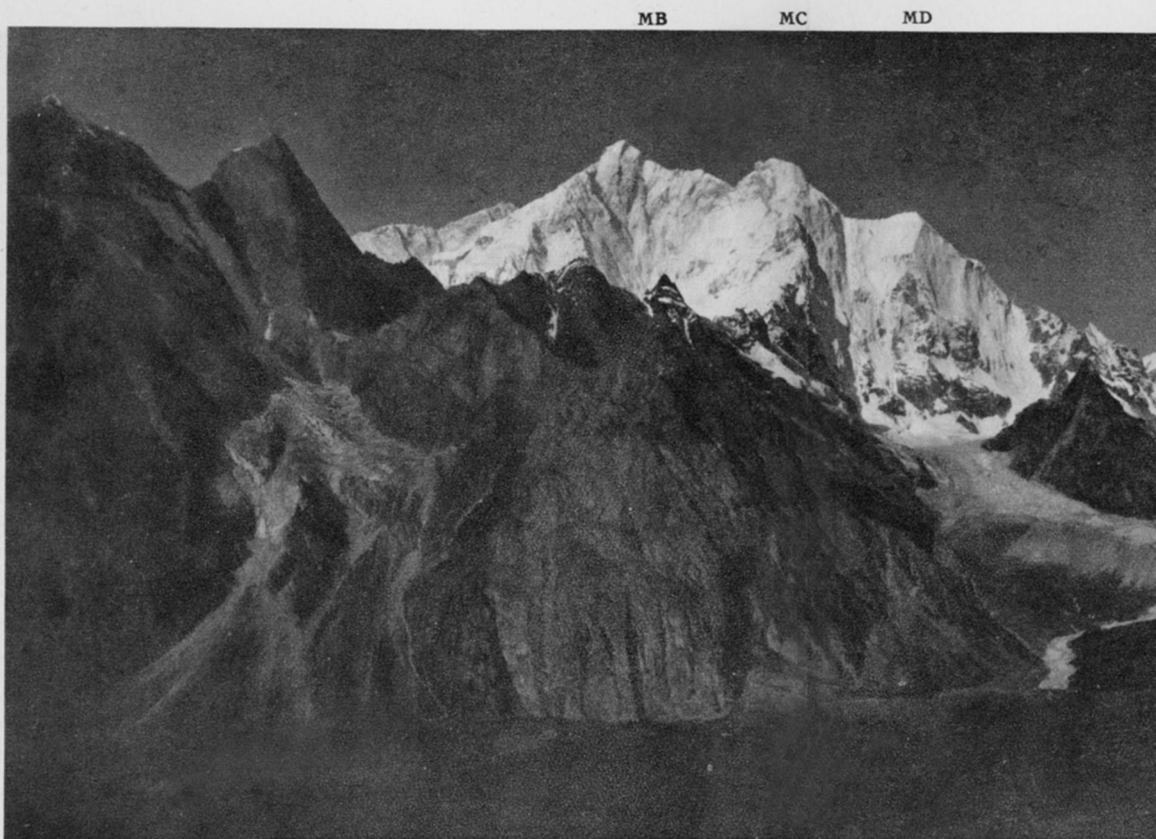


9. N 53 AND MAKALU FROM 20,400 FEET ABOVE KHARTA GLACIER

Phot. by A. F. R. Wollaston



10. THE NORTHERN AND WESTERN FACES OF MOUNT EVEREST FROM



11. THE VALLEY OF

South Peak  
Mt. Everest   ↓   AD   End of W. Ridge   24,000 Pk.

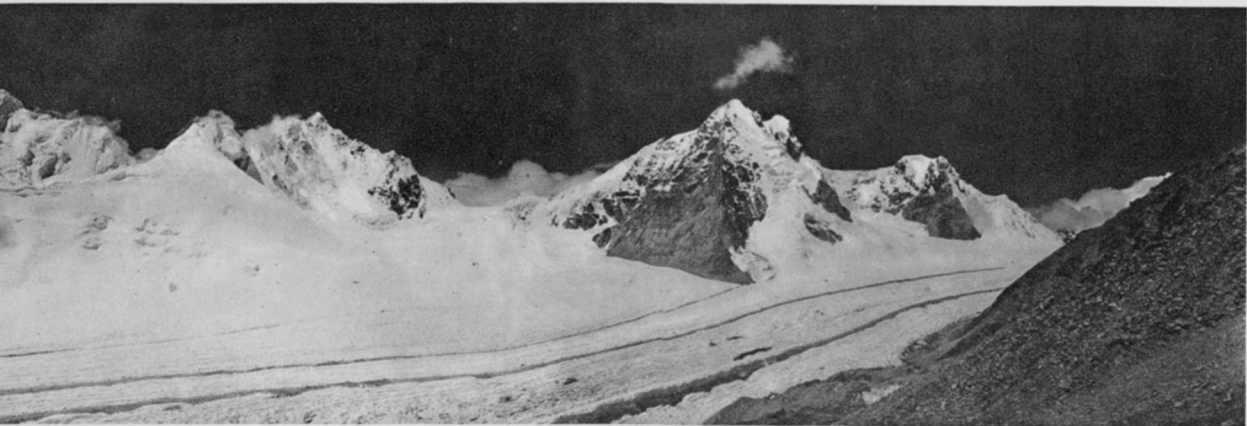


WESTERN FACES OF MOUNT EVEREST FROM A POINT AT 20,000 FEET ON THE SOUTHERN SLOPES OF PEAK 25,990, LOOKING ACROSS THE

MC   MD   EB   EC   ED   Mt. Everest



11. THE VALLEY OF THE KAMA CHU FROM ABOUT 16,000 FEET BELOW THE LANGMA LA



OF PEAK 25,990, LOOKING ACROSS THE WEST RONGBUK GLACIER

*Phot. by Capt. Wheeler, R.E*



THE LANGMA LA

*Phot. by Col. Howard-Bury, D.S.O.*



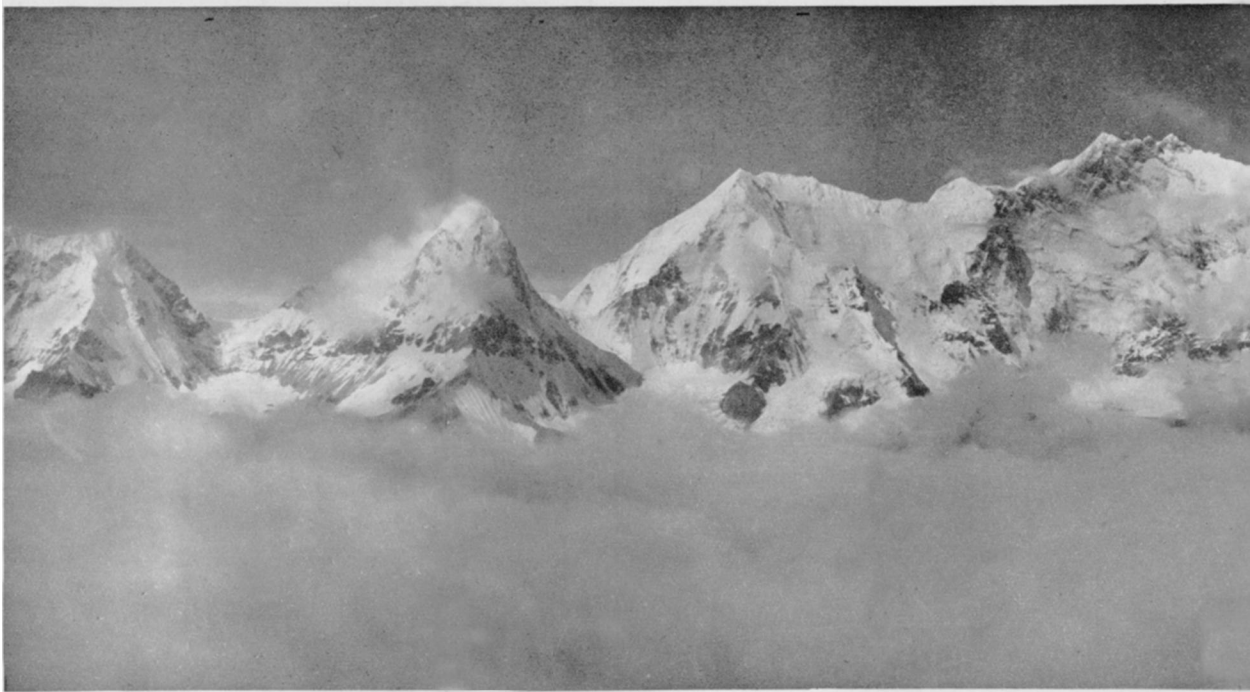
EA

EB

EC

ED

EE



13. MOUNT EVEREST FROM  
NEARLY THE SAME POINT  
WITH VALLEY CLEAR, BUT  
PEAKS MOSTLY OBSCURED  
BY CLOUD

*Phot. by*  
*Col. Howard-Bury, D.S.O.*



EB

EC

ED

EE

Summit

EG

EH

AA

EL



Summit



hit EG EH AA EL EM EN EO



12. MOUNT EVEREST FROM ABOUT 19,600 NEAR THE HEAD OF THE KAMA CHU, LOOKING ACROSS THE KANGSHUNG GLACIER OBSCURED BY CLOUDS IN THE VALLEY

*Phot. by  
Col. Howard-Bury, D.S.O.*

ummit

EM EN EO EP



Mt. Everest

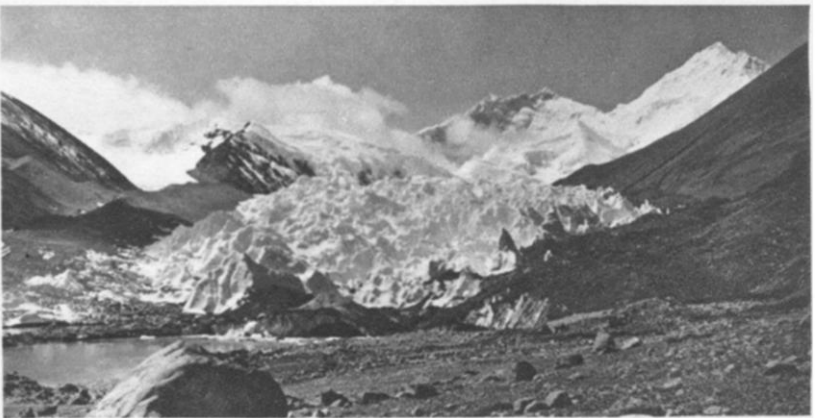
23,800



14. MOUNT EVEREST AND PEAK 23,800 FROM THE ADVANCED BASE CAMP AT 17,000 IN THE KHARTA VALLEY

ED EE

Mt. Everest



15. THE FOOT OF THE KHARTA GLACIER AT 19,000 FEET

EC

ED

EE

Mt. Everest



16. THE CAMP AT 20,000 FEET ABOVE THE KHARTA GLACIER  
Snow Peak 20,500 in foreground climbed by Mallory and Bullock on August 7th  
The arête on the extreme right of the picture is the route to the summit of Mount Everest

*Phots. by A. F. R. Wollaston*

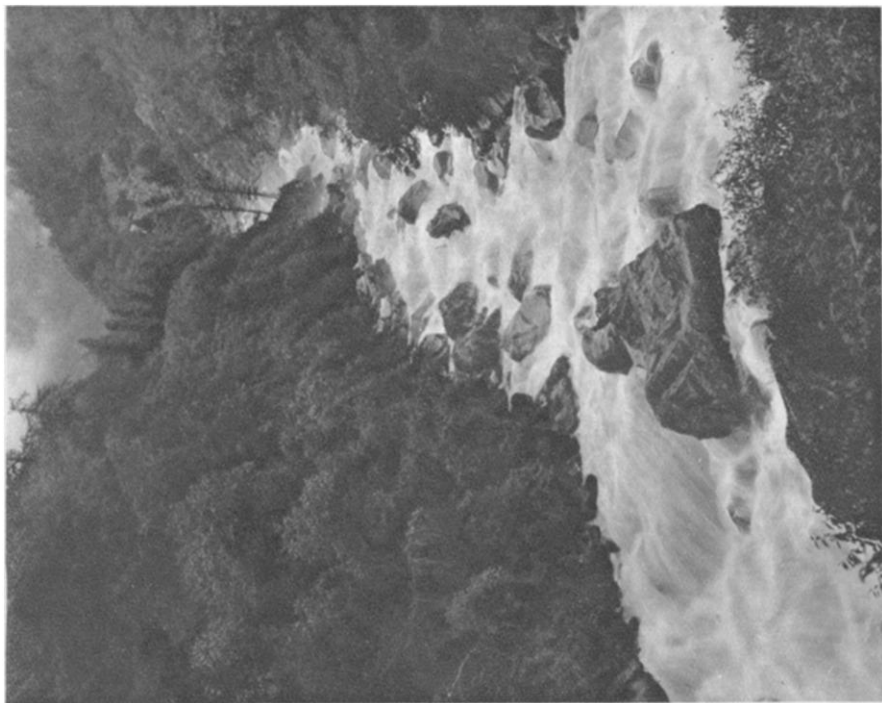


17. SILVER FIRS IN THE VALLEY OF THE KAMA CHU

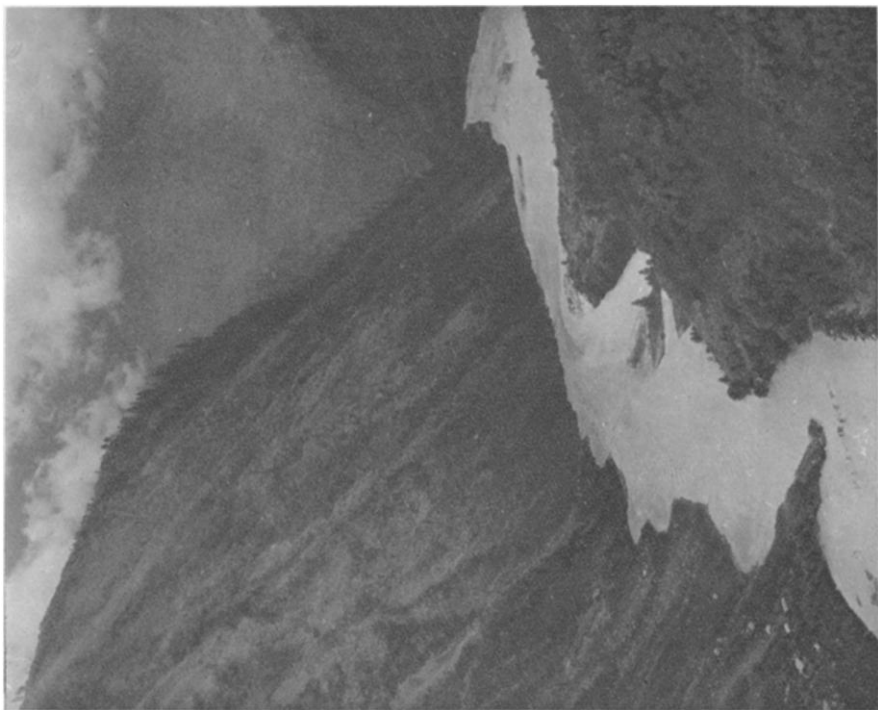


18. JUNIPERS IN THE VALLEY OF THE KAMA CHU

*Photos. by Col. Howard-Bury, D.S.O.*



19. THE RAPIDS IN THE LOWER VALLEY OF THE KAMA CHU



20. THE JUNCTION OF THE KAMA CHU WITH THE ARUN  
BELOW LUNGDÖ AT ABOUT 7,500 FEET

*Photos, by Col. Howard-Burys, D.S.O.*



21. VALLEY OF LAKES BEYOND THE SAMJUN LA, LOOKING SOUTH TO THE CHOG LA



22. LOOKING SOUTH FROM THE CHOG LA TO THE 24,000 FOOT PEAKS ON THE NEPAL BORDER



23. THE ARUN VALLEY FROM NEAR THE SUMMIT OF THE SAMJUN LA

The principal cause of the difference between the inhospitable west and the relatively inviting east of the Kama valley is presumably the great rift of the Arun valley, through which the monsoon works up to within a mile or two of Kharta. One may judge from photographs 1 and 2 that the pleasant site of the second base, on a wide river terrace high above the Arun, is just on the border-line between the arid plateau and the steaming valleys. Colonel Howard-Bury has described how the rain came up all through August to within a mile or two of the camp but seldom reached it. Just below the camp the great gorge begins, and only 15 miles further down horizontally—but about 5000 feet vertically—is the junction of the Kama Chu seen as a great swirl of whiter water in the centre of No. 20. The rapids in the lower valley of the Kama Chu (No. 19) must have the extreme slope of about  $5^{\circ}$ , or steeper than what is reckoned a steep hill on English roads. The forests of juniper and the silver firs (Nos. 17 and 18) lie some way down the river from the gorge whose beginning is seen on the left of Plate 11. The broad upper valley is bordered by an "alp" on its northern side, from which the cliffs of N 53 are photographed in Nos. 3 and 5. The glacier cavern of No. 4 is photographed from a point just above the Kangdoshang glacier which crosses the valley in the centre of No. 11.

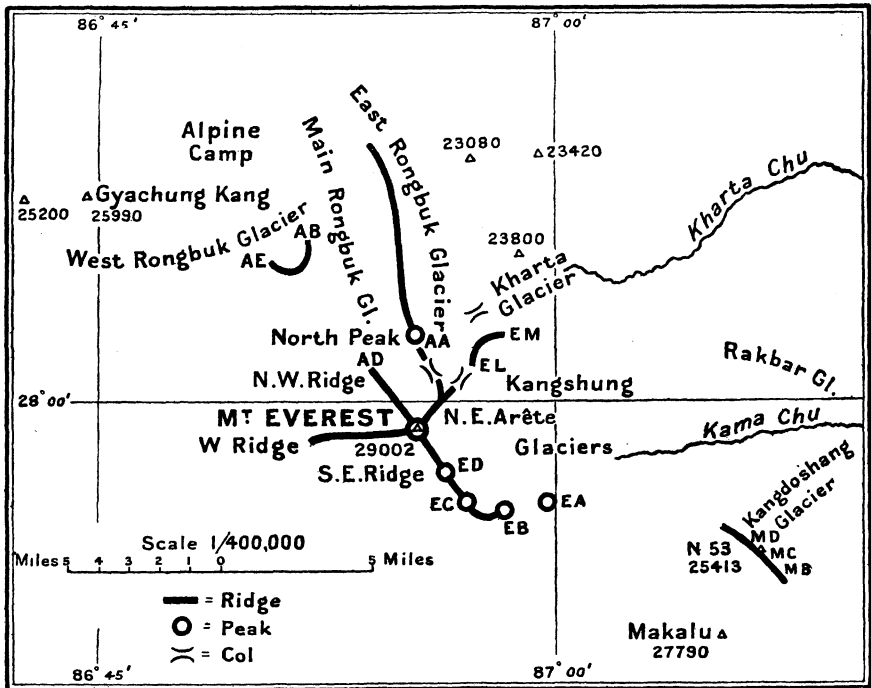
In the *Journal* for November we discussed and failed to solve the problem, What has become of the great rock peak seen to the right of N 53 in the photographs taken by Sella from the Chunjerma La and by Kellas from the Kang La. Some negatives just received suggest a solution which shows excellently how easily one may be deceived in studying mountain photographs. The missing peak is MC! We argued from the rules of perspective that MB, MC, and MD must be nearly in a straight line, and taking these three as buttresses of the mountain mass behind, calculated that from the Kang La one looked nearly along that line.

Now on his return from the high camp of September Colonel Howard-Bury went down by a snow-pass into the Kama valley and across the glacier to a saddle somewhere between Mount Everest and Makalu, whence he photographed N 53 from the other side. This seems to show that the face by now familiar to us, MB, MC, and MD, is not the buttressed side of a great mountain mass, but an irregular edge with cliffs on the other side as steep or steeper. If MC is thin, with nothing behind it, there is no reason why it should not be seen from the Kang La standing out a little in advance of MB, as Dr. Kellas' photograph shows. What we had taken for a solid house was only a front wall, and the missing peak stands boldly in the middle of the picture from which we had argued its absence. That, at least, is the solution which now seems fairly obvious. One might have guessed as much from No. 6, if the clouds had not concealed the critical feature MC.

When Colonel Howard-Bury was first at the head of the Kama



valley and took the photographs here reproduced in Nos. 12 and 13, he was never free from clouds, and we have no complete picture of the scene. Happily, however, there is a narrow zone above or below the clouds, as the case may be, common to the two pictures, and one can be used to supplement the other. They are taken from nearly, but not quite, the same point. On the plateau north of the mountain is a confusion of small peaks difficult to identify. AA is the "north peak" beyond the head of the East Rongbuk glacier; EL and EM are the extremities of a great cirque clearly photographed by Dr. Kellas from the Kang La, 90 miles away. EN is perhaps the snow peak 20,500



Rough diagram to illustrate the presumed topography of the Mount Everest group.

climbed by Mallory and Bullock on August 7, seen in Nos. 7 and 16. EP is apparently the triangulated peak 23,800, called for description the "Kharta Peak," seen in No. 14. The conjectural diagram used in the November *Journal* is here reproduced, for want of better. Later photographs confirm its rough accuracy, except that the fork of the north-east arête should be placed rather nearer the summit; and that, from Mr. Mallory's report, the west ridge starts from a point south of the summit, near the secondary peak of about 28,000 feet which he calls the "south peak" and which seems to be EE or perhaps ED.

Mr. Wollaston's pictures, Nos. 14-16, were the first to show the Kharta valley route. The advanced base in No. 14 seems to be under light

snow, and was not, to judge from the telegrams, always the cheerless place it looks here. One notes that the snout of the Kharta glacier is at 19,000 feet, much higher than those of the glaciers in adjacent valleys, and this may partly account for the choice of this route, which leads across below the snout at 19,000 feet (No. 15), and up the left bank of the glacier to the camp on bare ground at 20,000 feet: the "homelike" camp to which the party retreated when they were driven off the mountain by the blizzard. Much more complete pictures of this region, including the Lhakpa La, the head of the East Rongbuk glacier, and the col between AA and the arête, have now been received, and will be on view in the Society's house and at the Alpine Club.

The last three pictures illustrate the lake district in the country between Kharta and the lower Kama valley, briefly described in the last number of the *Journal* from Colonel Howard-Bury's cablegrams.

While members of this year's expedition are yet in Darjeeling on their way home, the Mount Everest Committee have been actively organizing the second year's work, and it is already decided that the expedition must leave Darjeeling not later than March 21, two months earlier than this year. Colonel Howard-Bury has reported that they are all of opinion that May and June, before the monsoon breaks, are likely to be the most favourable months for climbing the mountain, and that this year the expedition got to work too late. That was no fault of the organizers, who received the approval of the Government of India and the leave of the Dalai Lama only at the beginning of January. But the fact remains that this year the mountains were calm and clear while the expedition was on the march from Kampa Dzong to Tingri, and that bad weather set in only a fortnight after the reconnaissance approached the mountain: bad weather that persisted right up to the end of September when the onset of winter drove them from the field. The year 1921 may have been abnormal in the Himalaya as it has been in London: and the weather-experience of one year is not much guide to the next, since the only safe principle in applied meteorology seems to be that the weather is always abnormal. But in the critical second year the Committee must leave nothing to chance, and they are therefore preparing for a grand assault upon the mountain in May and June. It will involve a cold journey into Tibet: but there is no reason to fear any serious difficulty on that account, since comparatively little snow lies on the plateau, and the country is not so impassable even in the depths of winter as it has proved this year in the summer floods.

The Committee have learned with great regret that the distinguished chief of this year's expedition cannot return to Tibet next year. Colonel Howard-Bury has given two years in succession to the cause, and finds it impossible to spare a third. His able conduct of the negotiations in India in 1920 opened the way at the last moment when

it seemed definitely closed; and this year's success in the field owes everything to his skilful leadership and tremendously hard work. Rarely has an expedition added so much to geography in so few months and at so relatively small an expense; never, perhaps, has so important an undertaking been carried through within the estimated cost. When the accounts for this year are made up on the return of the expedition it seems likely that the position will be as follows. The subscriptions to the funds of the expedition for 1921 amounted to about £5600. All the expenses of this year being paid, it is probable that several hundred pounds will remain for next. Meanwhile, by the sale of the long telegrams from the expedition, and of a selection of the photographs more than £3000 will have been obtained. Arrangements have been concluded for the publication of a book in the early spring of 1922 with an account of the first year's work. From all these sources the Committee have in sight, by the time next year's party takes the field, a sum of between £4000 and £5000. The financial position of the undertaking is therefore remarkably sound; and the Committee can appeal with confidence for such further subscriptions from sympathizers with the great adventure as will allow them to make ample preparations for the second year—the culminating year, as they hope, of the enterprise.

Their first anxiety will be to choose a very strong climbing party. This year's reconnaissance has shown that the approach to the northern branch of the north-east arête is not too difficult; and the arête itself looks quite possible: but it is long and steep, windswept, and inhospitable, showing no very obvious shelter between 23,000 feet and 26,000 feet. Evidently it will be a tremendous task to establish a camp anywhere above the col. The Committee propose to equip a climbing party of six, with the intent that natural selection should operate in finding the three or four best fitted for the last stages of the ascent. Endurance and power of resisting cold will probably count for as much as skill in the refinements of mountaineering; and much will depend on a knowledge of how to make a comfortable camp in the worst possible conditions. For these reasons the Committee will try to secure that one at least of the party shall have polar experience.

The neighbourhood of the mountain has proved to be so much more interesting than it might have been, that there is full scope for as strong a staff of specialists as can be got together. Colonel Howard-Bury and Mr. Wollaston have secured great collections of flowers and seeds already; and the fauna, if not so rich as the flora, seems to be quite extensive, including the bear that masquerades as an "abominable snow-man." Full provision must be made for completing these natural history collections. We can hardly expect that Dr. Heron will have worked out the whole of the geology: in spite of Colonel Howard-Bury's hard work and wonderful success in photography this season, he has himself recommended that a photographic officer shall be sent next year to give his whole time to this

branch of the expedition's work. There is evidently full opportunity for a specialist in glaciology. The monsoon phenomena described in the chief's cablegrams are so significant that official meteorologists may see reason to revise the rather discouraging opinions they expressed when they were consulted last spring. Geodesists will naturally expect that every effort will be made to study the deflections of the vertical north of the Himalaya, and to swing geodetic pendulums as high as possible. Finally, it will be a thousand pities if an artist of the first rank cannot record the colour of the country, which is so glorious even in black and white.

There are also important questions of material equipment. The expedition has been this year at least three weeks away from the telegraph. Wireless communication between the separate parties and with the outer world would have been convenient this year, and may be more essential next, with its much longer season in the field. Again, this year communication and supplies were much delayed by floods, and it was believed that the only way to get to Kharta at midsummer was to go all the way round by Tingri. If light bridging material or a cable transporter could be provided for next year, it might very much facilitate an early arrival at the base. But all this would cost a great deal of money, and much will depend upon the support to be given by generous subscribers within the next few weeks.

It may be useful, then, to explain rather more fully the principles upon which the expedition has been financed. The foundation of success was the resolution that the value of any results should not be anticipated: there has been no mortgaging of the proceeds. No engagements were made for the sale of any reports, or of any photographs until the fund raised by subscription gave an assurance of providing for the whole expenses of the first year. When this position was secured, the committee were able in their own time to arrange for the sale of cablegrams and pictures, with all copyrights reserved to the Committee, and therefore with control of the various parts as components of one considered scheme of publication: the cablegrams for immediate news: the photographs in illustrated papers to supplement the cablegrams: a book of the first year's work to appear in the spring of 1922: and a series of lectures by one of the party in the principal cities of Great Britain to bring in further funds:—all for the continuance of the work in 1922.

The Committee had hoped to make an arrangement with a news agency that would have secured simultaneous publication of the cablegrams in all the principal newspapers of the country; but no sufficient offer could be obtained, and the Committee found also that if long reports went to all the London newspapers, no paper would give space to print them in full. In the end the rights in the cablegrams were bought by the *Times* and the *Philadelphia Ledger*; the *Times* included the cablegrams in its news service with the principal provincial papers of Great

Britain, and communicated them to several Indian papers, so that there was wide simultaneous publication, except in the London papers. The Committee had reserved the copyright in the cablegrams, and had stipulated with the purchasers for immediate publication that any paper should be at liberty to use them twenty-four hours afterwards; this arrangement was communicated to the London papers, but they took no advantage of it. Short, then, of giving away its valuable property for nothing, the Committee did all that it could to ensure satisfaction of the wide public interest in the expedition. This explanation is due to those who have regretted that many important newspapers have shown no interest in the expedition, and who may have concluded that there was some fault in the arrangements for publication made by the Committee.

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### NATURAL BEAUTY

**The Heart of Nature, or the Quest for Natural Beauty.**— Sir Francis Younghusband, K.C.S.I., K.C.I.E., President of the Royal Geographical Society. London: J. Murray. 1921. *Illustrations.* 12s. net.

THE book before us is interesting from several points of view. In the first place it is a fragment of autobiography: the revelation of a mind unfettered by ordinary conventions and singularly susceptible to the appeal of the external aspects of Nature. Sir Francis Younghusband's standpoint with regard to scenery seems to be very similar to that forcibly expressed by an eminent modern philosopher, the late William James, when he wrote "Scenery seems to wear in one's consciousness better than any other element in life. I have often been surprised to find what a predominant part in my own spiritual experience it has played, and how it stands out as almost the only thing the memory of which I should like to carry over with me beyond the veil unamended and unaltered. From the midst of everything else almost *surgit amari aliquid*, but from the days in the open air never any bitter whiff, save that they are gone for ever." Sir Francis's main purpose in the present volume is to insist on the importance of the cultivation of this sense of Natural Beauty—the taste for scenery as it is commonly called—and as a consequence to maintain that, since "any description of the Earth which excludes a description of its Natural Beauty is incomplete, Geography must include a description of Natural Beauty." To those who have for a generation striven to the best of their ability by precept and example to maintain this point of view it must be a great satisfaction to find it proclaimed *ex cathedra* by the President of our Society. If by some Sir Francis Younghusband's insistence may seem hardly called for, this will not be the view of those who have been intimately connected with geographical circles and teaching during the past fifty years. We are aware that there has always been a tendency—happily now a diminishing one—to ignore the etymological meaning of the word *Geography*, and to treat our science as concerned mainly with such facts and figures as can be incorporated in maps and Survey Reports. We have come across writers of scientific handbooks apt to indulge in a technical phraseology which often needs a glossary to make it intelligible to any but advanced students. There have been efforts in some quarters to deny the name of geographer to any traveller who did not

revelled in raiding. They cut up the caravans, and General Dyer was appointed to set matters right. Fortunately for him, Colonel Webb Ware had given the whole of his official life to opening up a caravan route across this inhospitable waste, to enlisting and training levies, and to establishing British influence. That his strong personality had been successful in this task, Dyer bears witness in his warm eulogy of Idu, who was his right-hand man throughout the campaign. Idu had been a leading raider until Webb Ware appeared on the scene, and won him over to the side of law and order.

Dyer had the difficult task of fighting a campaign almost without troops. However, with a mere handful of men and two guns, a force which gave out that they were the advance guard of a British army, he bluffed Jiand Khan and other chiefs into submitting and gained possession of Kwash. This was a case of "so far, so good," as it drew the raiders away from the lines of communication, but when they realized how they had been bluffed they were naturally furious. However, by the exercise of extraordinary skill, Dyer defeated Jiand and other chiefs, and the Sarhaddis finally accepted British control and enlisted as levies.

The book gives little geographical information, but clearly much survey work was undertaken, which will reach the map-room in due course. Routes were opened up, along which cars could travel, and the construction of the railway from Nushki to Duzdap on the Persian-Baluch border must have ultimately changed the entire situation. The light that is thrown on the point of view of the Sarhaddi raiders and of the staunch British levies is most instructive and deeply interesting. But the strongest impression that remains is that a handful of Indian troops and levies, under the inspiring leadership of Dyer, accomplished great deeds for the Empire with wholly inadequate resources. The book may be recommended strongly to the general reader and to all, old or young, who love to read of adventures which are stranger than fiction.

P. M. SYKES.

**Travels of a Consular Officer in North-West China.**— Eric Teichman, C.I.E. Cambridge University Press. 1921. *Maps and Illustrations.* 25s.

A preliminary and fairly detailed account of his journeys in Shensi and Kansu has been given by Mr. Teichman in the *Journal*, December 1916 and December 1918. In South Shensi these covered the country between the Wei and Han rivers, traversing and retraversing the Ch'in-ling range and the mountainous country to the south of it, of which I think Père David was the first explorer, rubbing shoulders against the Tai-pai Shan, 12,000 feet, and escaping near the source of the Han River of Szechuen and Chengtu. In East Shensi, the travels extended to Yen-an Fu, keeping both on the outward and return journey at some distance from the Yellow River, which entailed the constant crossing of deep rifts, with a south-eastern direction, in the loess land.

In Kansu, after reaching Lan-chou Fu by the Liu-p'an-shan route from Si-an Fu, journeys were made to the Ch'in-ling range, in the south and south-west of the Province ; to the irrigated lands fed by the snow-covered mountains near Liang-chou Fu in the north ; to Labrang lamasery and the border of Koko Nor ; and finally to Peking by raft, boat, cart, and rail.

An immense mass of valuable information regarding commercial routes, the courses of rivers and mountain ranges, forms the foundation of the volume. The journeys themselves throw a very interesting sidelight on the changes taking place in China. The mere fact that such an expedition should have received every assistance from local officials and been welcomed in every town is worthy of note. Alongside of this must be placed the new system of educa-

tion on foreign lines introduced after the Revolution. To the latter are also due new names of towns, new titles of officials, and direct correspondence between local officials and their provincial chiefs. And change is still at work. The relations between Tibet and China have changed since the date of the journeys; the cultivation of opium has revived; a new form of script has been introduced, which may be the prelude to a new era; and a colossal tragedy has occurred in the P'ing-liang country through an earthquake, which has occasioned not only a terrible loss of life, but presumably great changes in the local features of that loess country.

In some respects the journeys in Kansu are the more interesting part of the book. Apart from the fact that there is more incident recorded, the people themselves in their development of the lands wherever possible by irrigation, and the curious position of the Mahomedans, attract attention. Though the Mahomedans were massacred without mercy by Tso Tsung-t'ang in the seventies, and by Tung Fu himself in 1894, it is they who have been the most loyal upholders of the Peking Government. Mahomedan officials have shown themselves the most capable administrators, and it is Mahomedans who act as intermediaries between Chinese and Tibetans in trade. Of Tung Fu Hsiang's life Mr. Teichman gives a very interesting record, in connection with his home in Kansu.

While in North Kansu and in the Han and Wei valleys in Shensi the picture painted is very encouraging, in East Shensi and South Kansu White Wolf 'bandits, ex-soldiers, and soldiers have produced an area of almost complete desolation. It is pleasant to turn from such scenes to the beautiful country south of the Ch'in-ling range and on the southern borders of Kansu, where game of many kinds abounds in the forests, and one view vies with another in beauty, as shown in the photographs which richly illustrate the book.

Short as the volume is, it deserves a longer review, for there are many interesting points, such as the theory regarding loess deposits, which have necessarily to be passed over. The same thing may be said of the subject of the book, for throughout the reader feels with regret that so much of a personal nature has been omitted of which he would like to hear. The references to shooting experiences are specially tantalizing in their brevity.

Mr. Teichman complains of the badness of the maps to which he had access. It is to be hoped that Filchner and Tafel's maps may soon be reproduced in a form more available for later travellers than that of their original issue. The latter's maps of the Yellow River made from personal survey, extend from Tung Kuan, with the exception of a few gaps, to the source of the river, and contain many surprises.

The volume is well illustrated with photographs of people and scenery, and concludes with two chapters on the missionary question and railroads, which are well worthy of attention. Members of the China Inland Mission who recollect how they were criticized at the outset for adopting Chinese dress, may perhaps think it hard that the author should blame them now for thinking of giving it up, and yet the criticism in both cases does seem to have had some justification.

W. R. C.

#### AFRICA

**Collection des Ouvrages Anciens concernant Madagascar**, publiée sous le direction de **MM. A. Grandidier**, de l'Institut, **Charles Roux**, **H. Froidevaux** et **G. Grandidier**. Tome ix. Paris: Union Coloniale. 1920.

This volume contains two works on the early history of French colonization in Madagascar. The first is from the pen of Etienne de Flacourt, Director of