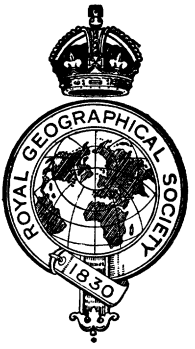
THE GEOGRAPHICAL JOURNAL



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The second of the three matters to which I would refer is the part which our Society has played in placing the teaching of geography on a sound basis. At no small sacrifice we have been making annual contributions for many years past to the schools of geography at Cambridge and Oxford. Those contributions will come to an end next year; but not before our object has been achieved. To the University of Cambridge belongs the credit of instituting a tripos in geography, and the number of students who are being attracted to it must be as gratifying to the University itself as to all others who have the interests of geographical teaching at heart. A perpetual supply of well-qualified teachers is now assured, and we may consequently look forward to geography taking its rightful place, with the assent of the Board of Education, in the scheme of advanced courses for secondary schools and in the list of subjects open to those who compete for scholarships at the Universities.

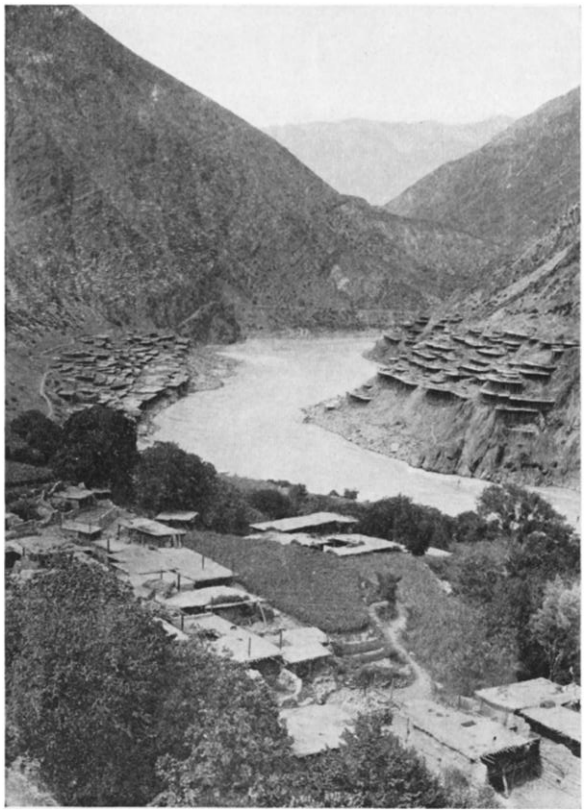
The last matter is the present position of the Permanent Committee on Geographical Names. I am glad to say that the response to the appeal which was launched by the President of this Society last year has enabled the Committee to carry on its work. The position however is still precarious, and in the absence of support from public funds nothing stands between the success and the failure of the committee but the financial support of public-spirited geographers. A mass of material is now in process of assimilation, and it would be little short of a disaster if this process were to be prematurely arrested.

With this commendation of an important enterprise to your favourable consideration, I bring my brief survey to a close. The conclusion which I draw from it is that the period of stagnation which set in in August 1914 in the sphere of active geographical work, as in so many other branches of human activity, has run its course, and that we have already entered upon a period of renewed and vigorous progress.

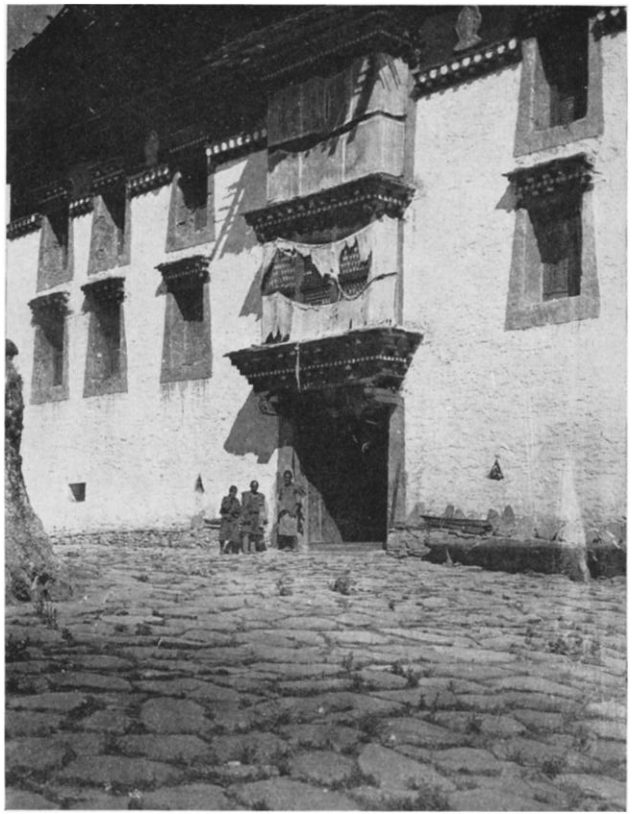
FROM THE YANGTZE TO THE IRRAWADDY

F. Kingdon Ward

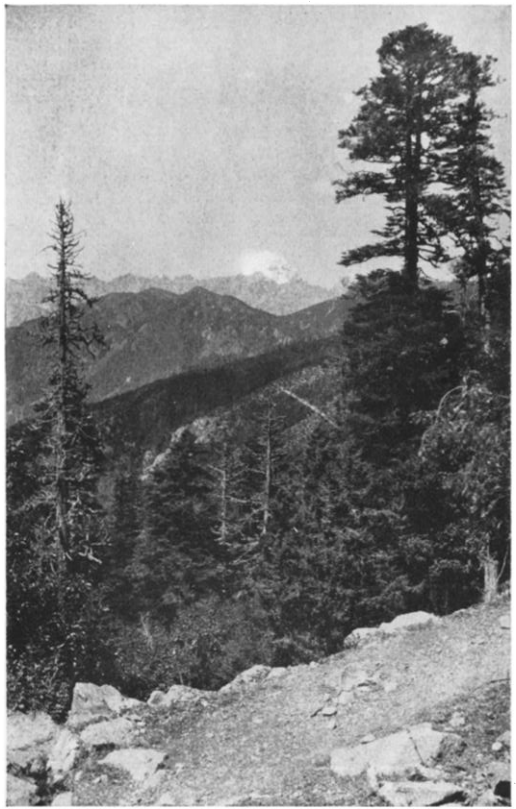
IN 1921 I went to Yunnan plant-hunting on behalf of Mr. A. K. Bulley and Mr. Reginald Cory; my intention then was that the trip should last about a year. Later in the season, however, I received further funds from the Government Grant Committee of the Royal Society, and with another grant from the Percy Sladen Memorial Fund I found myself in a position to make a second journey, calculated to last six months, but subsequently extended to the whole of 1922. I shall confine myself chiefly to this second year's travels. The region is not a new one, geographically speaking. Quite recently Professor J. W. Gregory and his son gave a brilliant account of their remarkable



SALT WELLS, YA KA LO



MONASTERY OF WARICHEN, NORTH OF MULI



DAMYON PEAK

THE GOMBA LA

journey across Yunnan last year. My traverse from the Mekong passed to the north of Mr. E. C. Young's route and south of Major Bailey's. In its first and last stages it corresponded with the route followed by Prince Henry of Orleans eighteen years ago.

There are certain extraordinary features of this river belt which carries the gutters of Kam. It is a strip of crumpled crust averaging about 75 miles wide over a length of 150 miles, as measured off the map, and may be regarded as a huge breach in the Asiatic divide. The western portal of the gap is formed by the broken end of the Himalaya where a great bluff overlooks the plain of Assam. The eastern portal is formed by a tangled skein of mountains in western China, flanking the gorges themselves. The two are connected by an arc of lofty mountains which form the rim of the Tibetan plateau and envelop the sources of the Irrawaddy. Thus four rivers, whose sources lie hundreds of miles apart, come charging down from the north, converge, rush side by side through this narrow gateway, and swing apart again to flow to different seas.

These rivers are, from east to west, the Yangtze, Mekong, Salween, and Irrawaddy; but the last named is, in this latitude, split up into the eastern branch, made up of four headwater streams, and the western branch. The eastern branch is the bigger, and of its four affluents the Taron (Chinese Kiu-kiang), which gallops along under the ramparts of China, is the main stream.

We find then a country of lofty parallel mountain ranges, separating deep river gorges, and therefore sparsely populated. There are many snow peaks, which stand with their roots firmly planted in the howling rivers and their heads 12,000 feet aloft. So abrupt is the slope from the river gorge to the summit of the divide that it is the exception to see any of the snow peaks from below, which probably accounts for the scanty references to them by earlier travellers. The flanks of the ranges are clothed with forests, and the whole country is a paradise of flowers.

One more point: The region is more lofty, the climate drier and colder, in the east than in the west; so that in our rapid traverse from the dry limestone plateau east of the Yangtze to the rain-drenched igneous ranges beyond the Salween, we shall notice a sharp contrast in scenery and vegetation. The hard dry atmosphere, the windy moors carpeted with alpine flowers, and the splintered mountains of the Tibetan Marches give place suddenly to the moist fœtid breath of the Irrawaddy, and to the heave and roll of endless smooth ranges covered with the soft green plush of the Indo-Malayan jungle.

I crossed southern Yunnan from Lashio viâ the Kunlong ferry to Ta-li. It is a picturesque but sparsely populated country, and the people seem to be very poor, especially in those parts inhabited chiefly by Shans. However, I will skip the intervening country with a stride, and come straight to Yung-ning, or Yung-lin, as the Chinese really call it; possibly

this is a transliteration of an original Tibetan name, Yungling, the word "ling" being a common termination for place-names in eastern Tibet.

We are now in the dry limestone country where the lofty ranges are rich with alpine flowers, including Rhododendron. There is a popular fallacy in this country that rhododendrons will not grow on limestone, but this is quite wrong. On these limestone moors and cliffs are found many species, such as *Rh. rubiginosum*, *Rh. sinolepidotum*, and several of the *Campylocarpum*, *Intricatum*, and other series. But it is chiefly for its herbaceous alpine flora that this country is distinguished. Over forty species of primula, five of meconopsis, many gentians, campanulas, cyananthus, lilies, and other flowers are found; whereas woody plants of all kinds are more poorly represented.

From the Tibetan Marches north of the Yangtze loop we turn westwards, cross the Yangtze by ferry-boat, and after marching north again, start the arduous ascent of the harsh range which for want of a better name we call the Yangtze–Mekong divide.

On this range are situated the Pai-ma-shan snow peaks, all that remain of a tremendous ice-cap which overflowed the valleys in every direction. I camped for a week under the shadow of Tsaya, the highest peak, taking my mules up to 16,000 feet. It was then August—rather the off season for flowers, which are particularly abundant here in spring and autumn. The weather was too bad for serious climbing, though I prospected possible routes to the summit.

The glaciers of Pai-ma-shan are mostly of what may be called the "amœboid" type—that is to say, they occupy slopes so steep that throughout the summer they are completely severed from their respective snowfields.

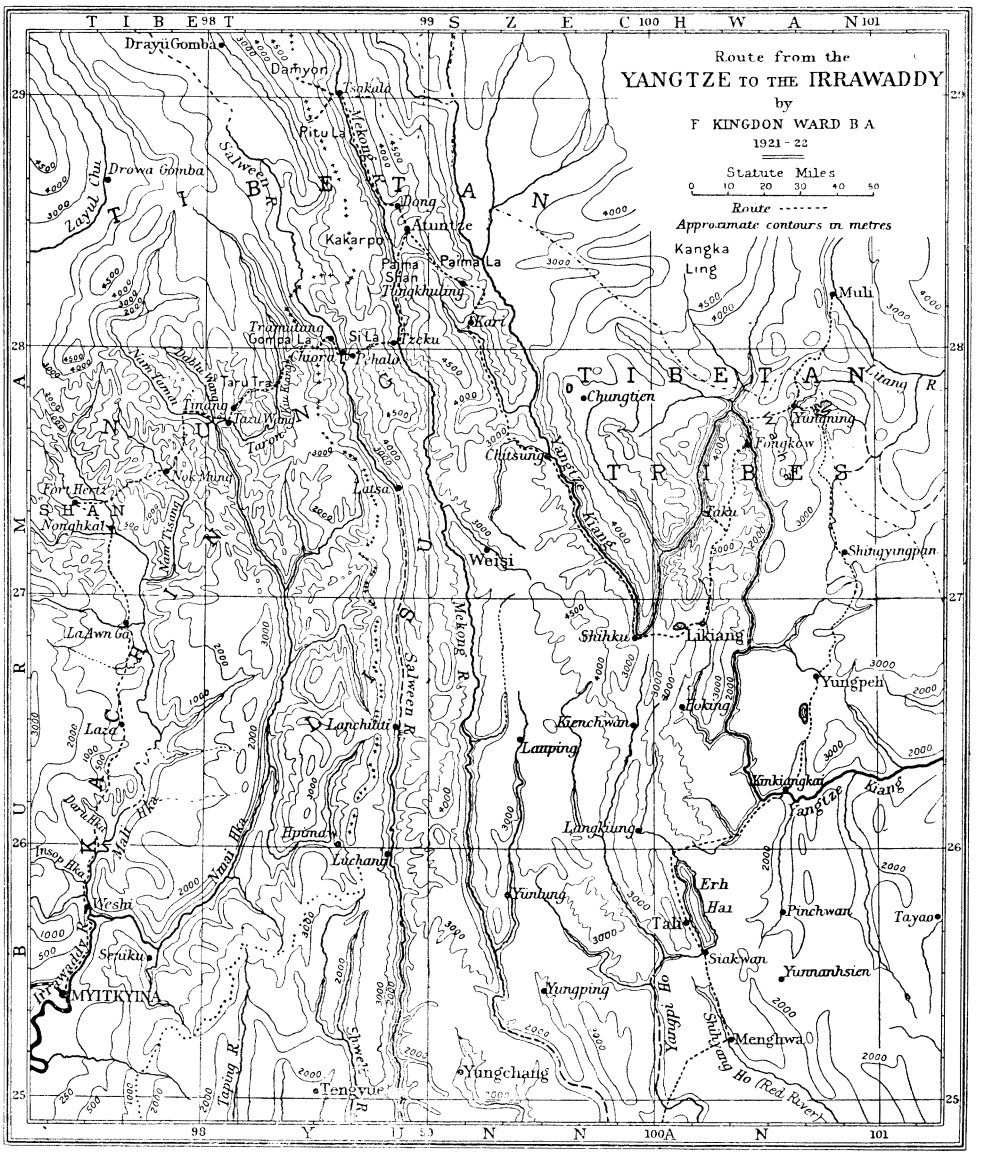
The glacier stream from Pai-ma-shan, flowing due south to the east of the snow peaks, is undoubtedly the source of the Kari river, and therefore flows to the Yangtze. On existing maps it is shown as flowing to the Mekong. (Kari, be it noted, means snow peak.)

Across the plateau-like summit of the divide, north of the snowy range (which is made of porphyry) is a high limestone escarpment, through which several streams have cut deep slots. Following up a stream through such a defile, I found above an uncharted sea of rolling downs extending in every direction. The contrast between the flora of this limestone escarpment and the porphyry range was very striking, some of the most conspicuous plants of all being found exclusively on one or the other.

Towards the end of August I went down to Atuntze, and thence, following the Mekong, reached Tsa-kha-hlo. One thing was very apparent as we marched up the gorges in bright weather: that, though there are no snowy peaks north of Ka-kar-po until the solitary peak of Damyon is reached, yet hidden away in the high valleys are numerous

glaciers. These may be distinguished as "dead" glaciers, because, being unconnected with any snow basin, their ultimate extinction is assured.

Damyon is a cupola-shaped snow peak on the Mekong–Salween,



or, more accurately, on the Mekong–Yü-chu divide. Its glaciers have retreated many miles, considerably further, it appears, than those of Ka-kar-po on the same range. They are still retreating.

It is interesting to note that the flora of Damyon is exactly like that

of Pai-ma-shan, on the other side of the Mekong, and much poorer in woody plants (conspicuously in Rhododendron) than the flora of the adjacent Ka-kar-po.

We spent ten days at Damyon and the Pi-tu La,* exploring passes and glaciers and making a collection of plants. I reached 18,000 feet here, at the summit of a " dead " glacier. Damyon itself must be about 21,000 or 22,000 feet. The foot of the main glacier lies at an altitude of about 17,000 feet.

From the Pi-tu La I caught sight of another range of snowy peaks just across the Yü-chu, and counted no less than nine glaciers, all on the east flank. Nothing is known about them, but, comparing their bearing from the Pi-tu La with Mr. Teichman's map of Kam, it is evident they are on the Yü-chu–Salween divide.

On the return journey south from Tsa-kha-hlo we followed the right bank of the Mekong. I had exchanged my Chinese mules for Tibetan animals, and we now got along much better. When directly opposite Atuntze, we ascended one of the Ka-kar-po valleys in order to see the glaciers. These reach much further down their valleys than those of any other snow peak we had seen, but, like all the other glaciers, are retreating.

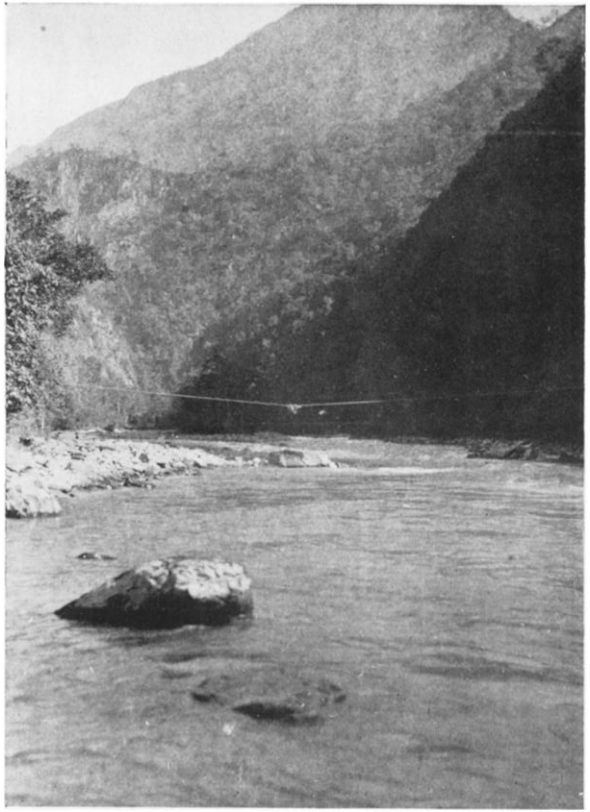
Thus we find in this region three distinct types of glacier : (i) ordinary live glaciers, always connected with their snow supply ; (ii) amœboid glaciers, connected with their snowfields for a portion of the year only ; and (iii) dead glaciers, unconnected with any snowfield, the peaks not rising above the present snow-line.

Continuing our journey south down the Mekong, we reached Tsekou early in October, and on the 12th started to cross the next great barrier to the west—the Mekong–Salween divide. Mules had now to be discarded and Tibetan porters engaged. The heavy baggage was sent down to Burma by the caravan road through Ta-li, and our kit reduced to essentials.

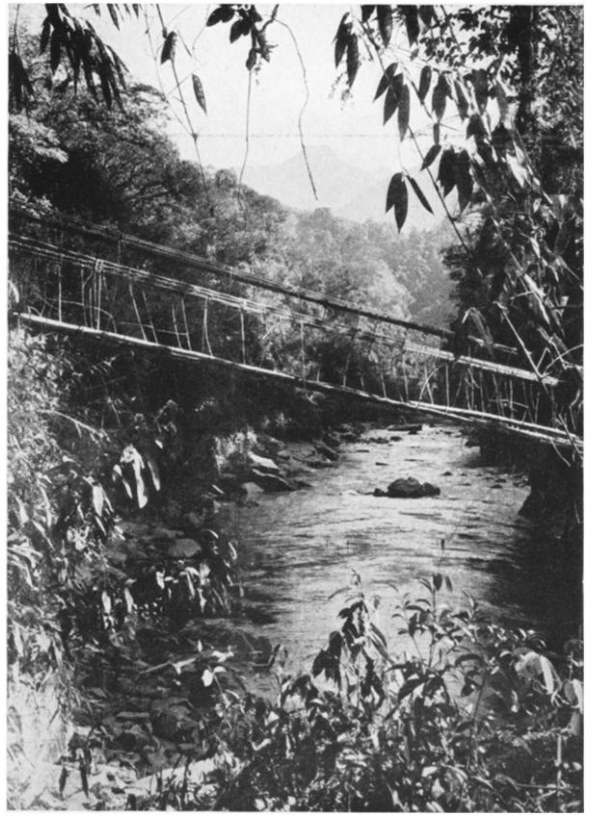
Crossing the Si La (14,000 feet) we dropped down into a deep ice-worn trench, called the " valley of hail " (Ser-wa Lam-pa), and on the following day reached the crest of a spur called Nyi-ser-ri-go (" the top of the mountain of yellow bamboo "). From here we had a fine view of the snow peak on the Salween–Irrawaddy divide called the Gomba La (" monastery mountain "). Some 20 miles of the glaciated rocky divide is seen, but the isolation of the Gomba La is complete—just a solitary snow dome, pushing out three considerable glaciers towards the Salween, all of which discharge into one big valley. Up this valley lies the road to India.

I spent three days with the French priest at Ba-hang, above the

* The Beda La of Major F. M. Bailey. Pi-tu is Mr. Teichman's Beto Gomba, which I visited in 1913. The Chinese call it Ts'a-p'u-to. If Mr. Teichman's rendering is correct, the pass should be called Beto La.



THE TARON RIVER, WITH MONKEY BRIDGE



THE TAZU WANG, WITH CANE BRIDGE

LISU YOUTHS

KACHIN GIRLS

Salween, while he kindly recruited seven Lutzu porters to take me to the Taron. But I was unable to engage an interpreter here. We reached Tra-mu-tang on October 19. Tra-mu-tang was formerly the seat of a small Chinese magistrate.

So far we had been meeting various Tibetan tribes, who however did not differ as much amongst themselves as any of them did from the people amongst whom we now found ourselves.

The Lutzu of the Salween, however, are almost identical with the Kiutzu of the Taron (or Kiu-kiang, just as the Salween is called the Lu-kiang by the Chinese), and the latter are in a general way the people we call Nung.* All told, the Lutzu do not number 7000 souls. South of their territory the Salween valley is inhabited by Lisus, who came from the east, just as certainly as the Lutzu came from the west.

We left Tra-mu-tang on October 20 and passed through the " marble gorge," which is choked with semi-tropical forest, ferns, and orchids. The first of the Indo-Malayan palms is seen here, and a little higher up are tree Rhododendrons of the *Oxyphyllum* series, which are not found farther east.

There had been a devastating flood during the summer. In the marble gorge the Salween had risen 40 feet, and the cliff path was simply pulverized, so that we had some difficulty in climbing over the wreckage. Just above the gorge the powerful glacier torrent from the Gomba La comes booming in over a chaos of boulders as big as cottages.

We now left the river and started up the cliff, climbing high above the torrent ; and almost immediately we were introduced to terrifying travel. The ledge along which we trod gingerly passed through a deep slot in the high granite cliffs, and a false step meant a violent death. It was easy enough for me, but for the porters with their loads it was another matter. Hence the method of carrying them by means of a strap round the forehead, leaving the hands free to clutch.

We followed the glacier torrent for three days, first through semi-tropical forest, then through Conifer forest, and finally through a chaos of boulders in a wilderness of shrubs. On either side were the high granite cliffs, and from our right streams from the big glacier, the edge of which we could sometimes see high above us, clattered into the valley.

This glacier, or another one, had originally flowed down the valley we were ascending and had left a curious mark, which was repeated in every valley we saw. Round the valley head, just below the crest of the range, ran a more or less level shelf, below which the flanks plunged steeply to the stream. Regarding the upper terrace as the floor, the valley was U-shaped ; but the lower part was V-shaped. The terrace marked the level of the old valley as carved out by ice action, while the

* The Chinese, coming from the east, called the tribes inhabiting the headwaters of the Irrawaddy Kiutzu. The Shans, coming from the west, called them Nung.

V shape was due to subsequent water erosion. This showed how far more active water was as a scouring agent than ice. On the third night we camped just below the pass, which we crossed next day. We had ten degrees of frost here under the fir trees.

At the foot of the pass is an extensive lake, from which the south-east face of the Gomba La rises like a sheer wall perhaps 2000 feet high. The pass is about 13,500 feet, and the peak itself cannot much exceed 16,000 feet. So that, although there is evidence of very considerable deglaciation on the Salween–Irrawaddy divide, the existing snow peaks are much lower than anything we have seen yet. This of course is due to the much greater precipitation. The natives assert that the glacier is now stationary, neither advancing nor retreating. I do not know whether this is so, but it is quite certain that all the former glaciers we had seen were in active retreat.

On October 23 we had a long march over the summit of the divide, traversing round cliffs and scrambling along ridges. To the north we could see a whole arc of glittering snow peaks. The Alpine region in which we found ourselves was a desolate wilderness of rock, but though of course there were no flowers, there were plenty of alpines in seed: not however as many as I should have expected. We tramped through miles of dwarf Rhododendron, very different from anything we had seen east of the Mekong. Some were creeping rock plants like ivy; others formed tiny bushes like heather. But there was not very much else, except a small Primula which covered acres of boggy slope. Where the flanks of the mountain faced the sun, all I found was the skeleton of a blue poppy.

We camped at dusk on a narrow shelf of rock, but there was no water and no firewood, so we could not do any cooking. However, early next morning we rounded a shoulder of the cliff and came to a glacier lake, where we halted for breakfast, right above the Taron gorge.

Despite a considerable descent through thickets of Rhododendron, which grew in a profusion and variety beyond belief, we did not reach the Taron gorge that day because the guide lost the path. But on October 25, after much climbing, we at last started on the final descent and emerging from the forest saw the Taron below us. It looked a puny stream, but we were still 3000 feet above it.

At lunch-time we reached the first Kiutzu cabin, a one-roomed shack, draughty and thatched with the huge leaves of a Panax.

In the afternoon we turned south down the river gorge, still keeping high above the Taron. There was a village ahead—four widely scattered huts, and here we hoped to pass a more restful night. However we found every hut empty—the inhabitants had fled to the mountains owing to an epidemic; and as the hut we selected for a night's lodging was simply sizzling with fleas, I kept to the open.

Next morning two Kiutzu came along. They were dwarfish, almost

naked, and covered with horrible jungle sores. However they understood my men, and offered to guide us, which was as well. None of us knew the way, and it was almost impossible to find it through the dense growth of grass, bamboo, bracken, and alder trees which clothed the mountain side.

The path up and down over the steep spurs was difficult. However on the second day, after a strenuous descent, we came to the edge of a cliff, and letting ourselves down by means of creepers camped in the bed of the Taron itself. The Taron is a beautiful river, but there is something ruthless and savage about it. The grade of the bed is very steep, and the river rushes impetuously along at the bottom of a richly forested gorge.

We now came in contact with more Kiutzu, or Nungs; and it was well we did, because we had to cross the Taron by a monkey bridge. This differs from the rope bridge of the Mekong in two respects. In the first place it is composed of four separate ropes of twisted bamboo, each about the thickness of a skipping-rope; in the second, the rope is not inclined but merely sags in the middle, so that instead of sliding across you have to haul yourself hand over hand. The Nung hangs underneath the rope attached to a runner, and pushing with his feet and hauling with his hands skims rapidly across. I might never have got across at all, if I had not been attached to a rope and pulled by a brawny Nung, like my own baggage.

We then travelled a full day's journey down the right bank of the Taron, and camped on a sandbank. My Lutzu porters would go no further. I had to exchange them for Nungs and, if possible, find an interpreter. We rested a day here, and I had leisure to examine the flora. Although the forest was now quite tropical in appearance, there were numerous Rhododendrons, very different however from those met with east of the Mekong. They belonged to groups better represented in Sikkim than in north-west Yunnan—*Edgworthi*, *Maddeni*, and so on.

I collected seven more porters here, and a Chinaman who had lived all his life on the Taron to act as interpreter; and on October 29 we resumed our march. It was six days' journey to the next river, the Tazu-wang, our route lying about west-south-west, and we had to cross a high range. For four days we struggled over the steep mountains, enveloped in gloomy forests, the chief feature of which was the magnificent tree Rhododendrons.

The Nung porters proved excellent. One of them was headman of a small village, and had brought his wife with him. She was an ugly little thing, hideously tattooed in blue, so that she seemed to be wearing a mask. The Nungs of the Taron are fairly well off in some respects, since Chinese traders from the east and Tibetan traders from the north can reach them. My men were well dressed for Nungs, and began

their meals with a wonderful menu, which included tea, *tsamba*, and butter. However, these soon gave out, and by the evening of the fifth day they had practically exhausted their rations.

On the fifth day we crossed the pass called the Taru Tra, which is only about 11,000 feet. When we left the forest we immediately got into that odious growth of dwarf bamboo which is the curse of these wet granitic ranges. It practically replaces the alpine herbaceous flora found further east, and the only thing which can compete with it is the Rhododendron carpet. There were still crowds of Rhododendrons of all shapes and sizes, though even they were kept well in check by the bamboo. Early as it was we had snow crossing the Taru Tra. The valley heads, though not glaciated, show clearly the effect of a deep pall of snow, which persists through about seven months of the year. The valley head is surrounded by a smooth granite wall, which forms a complete semicircle about 1000 feet high, with a curiously level top. It seemed impossible to escape from the *cul-de-sac* in which we found ourselves. However we scrambled up a scree and eventually reached a col, the Taru Tra pass.

From here we had an amazing view westwards, over the endless rounded ranges and wide wet valleys of Indo-Malaya. The sun came out and shone on the jade-green jungle, and on the waves of cloud which came rolling in from the west. But when my interpreter saw it he shook his head sadly; and I knew I should never persuade him to go all the way to Hkamti Long.

The descent to the Tazu river, reached the following evening, was a straightforward affair, and here we reached another village and I had to change porters. My interpreter also left me, saying that he must go back with them, as he was afraid to cross the Taru Tra alone. Before he left he handed me over to the Nungs with instructions to take me to Hkamti Long somehow.

These Nungs were rather different from those of the Taron. The faces of the women were not so heavily tattooed and the pattern was quite different, comprising a few curved lines reaching from one angle of the mouth to the other, and a tiny circle on the tip of the nose.

The girls are tattooed between the ages of fourteen and seventeen. There is no special ceremony. Men are never tattooed. The reason for it is probably to safeguard in some degree the women, who are carried off into slavery by the Tibetans, though men are also taken. They do not appear to be ill used, however, and enjoy comparative freedom, though they have to work. The further west we went the less tattooing I saw, so that the above explanation has a certain amount of support.

From a shoulder above the Tazu we saw a strange sight. The Taron, which we had left a week ago flowing due south, came into view again, rumbling up *from* the south, presently to turn west just where the Tazu joined it from the north. The Taron makes a big loop round the end of

the Taru Tra range, and we had simply crossed over from one limb to the other.

We crossed the Tazu at the confluence by cane bridge, and immediately found ourselves on the main road to Fort Hertz, which was said to be only eleven marches distant. We followed the Taron again for a day and a half, then crossed the Dablu river, and immediately afterwards reached the beautiful Nam Tamai. Day after day we marched through luxuriant forests, the trees of which were now crowded with orchids, ferns, and other epiphytes, including a lovely Rhododendron covered with milk-white blossom.

After crossing the Nam Tamai we reached the summit of the next spur after four hours' climbing, and found ourselves on the crest of the range which divides the eastern from the western Irrawaddy. From here we had a fine view of the snow peaks to the north, where the Nam Tamai rises, and of the flat valleys and low billowy ranges of the western Irrawaddy below.

Another eight marches through the jungle, where the tick and hiss and clack of insect life, the joyous cry of the hulock monkey at dawn, and the monotonous screech of birds told us that we were far down in the Indo-Malayan jungle, and we stood on the last ridge. The spurs flared away westwards to the honey-coloured plain ; and in one pregnant hour we raced down to the western branch of the Irrawaddy.

But what a change! Instead of the bucking, roaring rivers to which we had been accustomed, a broad expanse of unruffled surface. The water slid easily along between walls of forest.

From here to Fort Hertz in Hkamti Long was only a day's march, and we arrived on the afternoon of November 16, five weeks after leaving the Mekong. Here I was hospitably entertained by the officers of the Military Police and the Deputy-Commissioner. From Fort Hertz I turned south down the valley of the Mali Hka, reaching the rail head at Myitkyina in fifteen days. There is an excellent mule road now, with bungalows at every stage ; and many of the Kachin clans, both from administered and unadministered territory, are met with going south to buy salt.

I was able to confirm the conclusion that the Mekong–Salween divide, up to the 28th parallel, forms roughly the boundary between a Chinese flora to the east and an Indo-Malayan flora to the west. Beyond the 28th parallel this function is performed by the Salween–Irrawaddy divide. Further, the western Chinese flora is itself divisible into two, a northern and a southern. It will probably be found that the division between them east of the Yangtze follows the continuation of the Himalayan axis ; though until we know where that is, we may regard the Yangtze itself, east of the great loop, as the boundary.

Between the Yangtze and the Indo-Malay boundary to the west the

division between north and south-west China floras is more complicated. It crosses the Mekong-Salween divide and the Yangtze-Mekong divide in about lat. 28° 30′, and, following the Yangtze valley south, turns east again so as to leave the Likiang range in the Yunnan area.

As regards the deglaciation which has taken place all over this area, I have suggested that it increases progressively from west to east, as the climate grows drier in that direction ; and that this is due to a progressive elevation of the river divides, those further east having been elevated first, or higher, thus gradually cutting off the rain-bearing winds from the south-west.

The explanation appears to me to be this: The parallel ranges between the Yangtze and the Irrawaddy have been elevated successively, owing to pressure acting from the west. On the cessation, or slackening of this pressure, the weight of the anticlines as they slipped down the thrust plane, tore open the chasms in which now flow the great rivers.

Professor J. W. Gregory, who, accompanied by his son Mr. C. J. Gregory, visited Yunnan in 1922, puts forward another and simpler explanation of the facts. He maintains that Yunnan is a region of subsidence, and points out that if there had been the regional uplift claimed by some geologists, the glaciers should have increased; whereas they have certainly diminished (*Geogr. Jour*, March 1923). There is, he says, no evidence for recent elevation, and the fact that no raised beaches are found on the west coast of Burma is against it.

Nor does Professor Gregory consider that the parallel ranges have been differentially elevated, consecutively from east to west. In his account of the country he has shown that Yunnan is a dissected plateau, and holds that, despite the north-and-south grain of the ranges, the axis of elevation really runs east and west, as in the Himalaya; whatever pressure acting from the north or from the south gave rise to the latter gave rise also to the former, whereas the theory of differential uplift for the parallel ranges requires pressure acting either from the east or more probably from the west.

Professor Gregory, while admitting that the decrease of the glaciers is probably due to decreased precipitation, considers the latter to be a purely local phenomenon, not necessarily connected with variations in the level of the land.

But the question still remains: what caused the decreasing precipitation? Moreover, although it is true that depression of the area would automatically cause a shrinkage of the glaciers, it might also cause an increase in precipitation by lowering the barrier which had been raised against the moisture-bearing winds from the south-west.

It would depend to some extent on the amount of subsidence whether these two tendencies balanced one another or not. But it is hardly possible to conceive the entire region subsiding equally in every direction; the weight supported by the crust is too unevenly distributed for that.

And so it is quite possible that so far as the parallel ranges are concerned differential subsidence took place, the western edge of the plateau sinking more than the eastern.

Professor Gregory insists on the fact that the Yunnan plateau slopes from north to south. But this is only what one would expect, since the drainage is entirely from north to south. Not only do the main rivers flow south, but the tributary streams also; they follow the strike of the rocks for long distances, only to cut their way through to the main rivers at the last possible moment.

Moreover, a plateau *must* slope down not merely in one direction but in every direction, unless indeed it is bounded by escarpments; and I do not think Professor Gregory has entirely disposed of the remarkable westward slope, as revealed by the progressive lowering of the river-beds as one travels westwards. Professor Gregory attributes this to the greater erosive power of the rivers themselves owing to increased rainfall in the west; but this hardly seems to me to be an adequate explanation.

The Salween is obviously a smaller river than the Yangtze, yet it lies over 2000 feet lower. The Taron, again, is much smaller than the Salween, yet it lies slightly lower.* The Nam Tamai has a smaller discharge than the Taron, yet lies lower, and the Mali hka again lies lower than the Nam Tamai, in spite of its smaller discharge.

The western source of the rain does not seem to demand this regular sequence of grading, irrespective of the size of the river. If climatic conditions alone are responsible for the lower height of the western rivers, there should be a big drop in the bed of the Salween itself in the course of those 30 odd miles where the climate changes from the drought of Tsa-rong to the monsoon conditions below Tra-mu-tang. But in following the Salween from Tra-mu-tang to Menkong I have found no such abnormal change of grade, though certainly there are big rapids here. Moreover the precipitation does not increase progressively from east to west. There is a dry belt east of the Mekong, and a wet belt west of the Mekong; and within the limits of each the variation is probably negligible. At least we may be sure that within the Irrawaddy basin itself the precipitation is comparatively stable, yet we find a regular slope to the west, if we regard the river-beds; similarly east of the Yangtze the rainfall is from our point of view constant.

It seems to me that on the question of deglaciation no final conclusion is possible until we know much more about the country—the heights of existing snow peaks, and of the snow-line both east and west of the

* Professor Gregory quotes Mr. E. C. Young to prove that the 'Nmai hka or eastern branch of the Irrawaddy has a larger discharge than the Salween where he crossed those rivers (lat. 26°) in spite of its much smaller collecting ground, which is about one-eighth of that of the Salween (north of lat. 26° Salween = 40,000 square miles, 'Nmai hka = 5000 square miles). But the discharge of the Taron (lat. 28°) is not half that of the 'Nmai hka (lat. 26°); whereas the discharge of the Salween in lat. 28° is very much the same as it is in lat. 26°.

Mekong, the extent of deglaciation, the exact direction of the prolonged Himalayan axis, and many other things.

It is undoubtedly difficult to prove that deglaciation has proceeded further in the east than in the west, and the extensive deglaciation of the Salween–Irrawaddy divide, which I had not suspected, does not make it any more easy. In fact, so far I have failed to find any range in the west on which the glaciers show no signs of retreat. The Taru Tra range * immediately west of the Salween–Irawaddy divide has never been glaciated at all—at least, not where I crossed it. But at least we may say that while all the glaciers east of the Mekong are in active retreat, those of the much lower Gomba La are perhaps stationary.

Before the paper the PRESIDENT said: Mr. Kingdon Ward requires no introduction to an audience of the Royal Geographical Society. He has already on previous occasions spoken to us of Western China. Since that time he has added to his knowledge of that interesting part of the world by further expeditions; an expedition which occupied the greater part of 1921, and another which he undertook the following year. Of his experiences on this latter expedition he is to speak this evening. He has on previous occasions endeavoured to cross from China to the Irrawaddy river, but until 1922 all his attempts to do so had been foiled. On the last occasion, however, he was successful, and carried his journey through from Western China to the Irrawaddy in Burma. He will show us, I am sure, an excellent series of pictures of the high mountain country which he travelled over, from the plateaux east of the Yangtze down into the tropical regions of Northern Burma. I will not stand longer between him and you, but will ask him now to give us his paper.

Mr. Kingdon Ward then read the paper printed above, and a discussion followed.

The PRESIDENT: General Davies, to whom reference has been made by the lecturer this evening, is happily present. The maps which we possess of that part of the world are all based upon General Davies' own surveys, and I am sure you will be glad to hear a few words from him on the country of which we have had a description.

Major-General H. R. DAVIES: I am afraid it is now twenty-three years since I was in the country that Mr. Kingdon Ward has been describing to us this evening, and so you will not certainly expect from me very recent information. But having travelled there does enable one to appreciate the journeys that the lecturer has made, for this is by no means his only journey. On and off for years he has been travelling in that part of the world, and he is at present the greatest authority on the country and its inhabitants. I am grateful to him for his lecture this evening, and for the beautiful photographs that bring back so vividly some of the scenes that I saw long ago. Any one who has travelled in that country would wish to travel there again. I can appreciate also the difficulties of his journey. Among many of the tribes in Western China travelling is quite easy, but that is not so when one gets among the Tibetans; at least it certainly was not so twenty years ago. They were then a suspicious people; they live in very remote places and very seldom

* Taru Tra is the name of a pass. There appears to be no name for the very conspicuous range itself, which in accordance with previous nomenclature might be called the Taron-Tazu divide.

see strangers, and I think it is natural that on seeing strange-looking and curiously dressed people coming through their country, they should be somewhat alarmed and not always very friendly. But that feeling among Tibetans has changed of late years; they have got more used to travellers. One proof of that is a journey made a little while ago by one who has travelled widely in China, General Pereira, who succeeded in getting through from Peking to Lhasa, the first time, I believe, that that journey has been accomplished since the French missionaries Huc and Gabet did it in the forties of the last century. General Pereira was surprised to find on arriving in Lhasa not only that he was treated in a very friendly manner, but that there was a telegraph office from which he was able to send off a telegram announcing his arrival. Mr. Kingdon Ward has not mentioned any Tibetan hostility, and I think that in Eastern Tibet they may be less suspicious than they were; even in past days, when they got to know one, when one went back to a village previously visited, one was always well received.

The tribes of that part of the world are very interesting, and there are many of them, speaking different languages and calling themselves by different names; but the way in which they are split up is due largely to the nature of the country. I think that they all owe their origin to two or three main stocks, and that when some of the tribe have emigrated and gone a few days' journey to another valley, it was natural, owing to the difficult nature of the country, that they should not have much communication with their original home, so that people once of the same race have now split up into many different tribes, speaking different languages.

I also tried to get through to Assam, but failed owing to Tibetan hostility and owing to the rope bridges being cut. So I can appreciate what the lecturer did in the last part of his journey, through a very little known and uninhabited jungle country.

Sir DAVID PRAIN: It is thirty years ago since I was interested in the vegetation of that country of which Mr. Kingdon Ward has told us this evening. He was on the border between what you might call the Chinese flora, the drier flora, and the Indo-Himalayan, the very moist and rich verdant vegetation filling all the western valleys. From the pictures that he showed us those who have lived in Assam, as I have, would feel they were looking into the forests that they were familiar with there. I know, because my friend, Lieut. Pottinger, as he was then, stayed with me before he made an attempt in 1897 to go up the eastern branch of the Irrawaddy, and when he was there I made through him the acquaintance of another friend, Lieut. Cruddas, who I am afraid is dead now. Lieut. Cruddas, who was the commandant of the battalion of Frontier Police at Myitkyina, was good enough to look after a posse of native collectors whom I sent up to get specimens from that area, and we found that the actual species, though not quite the same as in the Brahmaputra valley, were very nearly allied, and that the vegetation as a general vegetation was the same in the two valleys.

The PRESIDENT: If one is to obtain an adequate idea of a country of which one has no personal experience, one can only do so by obtaining descriptions of it from different points of view. Earlier in the present session we had a description of Western China by Prof. Gregory from the point of view of the geologist, and he showed us an admirable series of pictures taken largely from a geological standpoint. This evening we have had a description of the same part of the world, though not actually quite the same district, from a different point of view, that of a botanist, and we have been shown this even-

ing a most admirable series of photographs taken, largely, from the point of view of a botanist. I am sure that the descriptions of the flora which Mr. Kingdon Ward has given us have added enormously to our knowledge of the country, derived originally from the description given to us by a geologist. But Mr. Kingdon Ward, clearly, is not only a botanist. He has given us also much information purely geographical. He has told us about the glaciation, and has described three different types of glaciers, and in every case they were retreating. The ordinary layman who, like myself, assumes that this planet is gradually getting colder is always a little surprised when he finds that things such as glaciers are disappearing, and he naturally seeks for some explanation of this rather unexpected phenomenon. There are, I believe, various explanations. Some modern scientists will tell you that the world is not getting colder owing to radio-activity, but they have only come to that conclusion since the discovery of radium. I believe that the real cause which affects glaciers is the difference between the melting and evaporation during the dry months and the amount of moisture deposited during the wet months. It would appear, therefore, that the climate in this particular part of Western China is at the present time becoming drier. I believe that Prof. Gregory came to the same conclusion, though I am not sure that he agrees with Mr. Kingdon Ward as to the particular reason. However, that is a matter which I am prepared to allow the botanist and the geologist to fight out between themselves.

I am sure that you are all most grateful to Mr. Kingdon Ward for his excellent description of the country and the humorous narrative of his journey across it. On your behalf I offer him your sincere thanks and congratulations on his safe return.

THE BANDA ARC: ITS STRUCTURE AND GEOGRAPHICAL RELATIONS*

J. W. Gregory, F.R.S.

Read at the Afternoon Meeting of the Society, 14 *May* 1923.

THE succession of mountain chains between the Pyrenees and New Guinea is the longest fold-mountain line on Earth. Its western end is cut off abruptly by the Atlantic. Its eastern end towards the Pacific is uncertain; a southern loop forms the Burma Arc and the Malay Arc, which, according to the hypothesis that appears now to be most generally accepted, was stopped east of Timor by the resistance of the Australian platform; the Malay Arc according to this view was either bent back in an open curve like a fish-hook forming the Banda Arc along the eastern and northern margins of the Banda Sea, or as an ellipse enclosing that sea (Verbeek and Fennema, 1896). According to an alternative hypothesis, however, the Malay Arc and the islands north of the Banda Arc continued eastward as the mountain chains of New Guinea. The view that the Banda Arc is the continuation of the Malay Arc has been widely adopted, owing to its advocacy by those

* The place-names are spelt as on the Admiralty Chart No. 942, B, Eastern Archipelago, Eastern Part, sheet 2 (corrected to 1922).

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THE GORGE OF THE ARUN

Captain C. J. Morris, 3rd Q.A.O. Gurkha Rifles

Read at the Evening Meeting of the Society, 18 *June* 1923.

WHEN the monsoon put an end to our climbing activities on Mount Everest it was decided to go down to Kharta for a short rest before returning to India, and if the weather permitted to visit the Kama valley. On the morning of 10 June 1922 we looked on Mount Everest for the last time, and proceeding *viâ* Rebu and the Doya La reached Teng, at the entrance to the Kharta valley, on the 14th, after a quite uneventful journey. Major Norton and Captain Bruce had been awaiting us for some days, as they had come on before us in order to try and recuperate from the effects of their frostbite.

The Arun, one of the principal tributaries of the Kosi, rises behind the main chain. It drains the plains of Tingri and Khamba in Tibet, and then with the force of its accumulated waters carves its way through the main chain of the Himalaya directly between the gigantic mountain massifs of Everest on the one side and Kangchenjunga on the other. Between our camp at Teng and the village of Kyimateng, a distance of only 20 miles in a straight line, the river drops 4000 feet. We were particularly interested to explore this part of the Arun, and to find out whether this tremendous drop consisted of a series of great rapids and waterfalls, or of a steady fall in the bed of the river. Also it was quite apparent from our view of the river from Teng that the gorges would be of the very greatest interest. But it was doubtful whether we should be able to undertake this journey on account of transport difficulties and weather. In the mean time we made arrangements for the whole party to go over to the Kama valley.

Having dumped all our heavy kit we set off on our first march. It was a short one of only a few miles, for it was necessary to halt for the night at Kharta to pay our respects to the Dzongpen, who had done so much for the 1921 Expedition, and in whose district we were now travelling. Although the Kama is only two marches from here, and also forms part of the Kharta district, the Dzongpen told us that during the ten years in which he had held office he had found it quite impossible to visit the country thereabouts, as he had been told that it would be necessary for him to go a portion of the way on foot owing to the state of the roads,

and he considered this an indignity he did not feel justified in submitting to. I think this attitude is quite typical of the ruling classes in rural Tibet, and must in a great measure account for the slack way in which the country is governed in the less-frequented parts. In the evening the Dzongpen entertained us all to dinner, but not having been brought up to eat macaroni with a pair of slender chopsticks and to consume numerous cups of tea spiced with butter and rock salt, I cannot say that I thoroughly enjoyed the function. However, the ever-thoughtful Norton had tactfully arranged that the courses of the Dzongpen's dinner should be alternated with others of our own cook's manufacture, and this most skilful arrangement saved the majority of us from going hungry to bed.

On the following morning we were off early, as we had a long uphill march over the Samchung La. Looking back from the top of the pass one has a wonderful view right up the part of the Arun valley which lies in Tibet; but on the other side of the pass a still more wonderful sight was in store for us, for here the ground was covered with bright yellow primulas (Sikkimensis) and dwarf rhododendrons in full bloom. We could see nothing of the country in front of us, as a thick mist was drifting across from the Chog La and it now began to rain. As we reached the bottom of the pass the mists cleared a little, and we were able to catch a glimpse of the road we had just descended by. We pitched our camp on the banks of the beautiful lakes in the valley between the two passes, but it was not until early the following morning that we were able to realize the full beauty of the scenery surrounding us. I have never seen such wonderful colouring in water, ranging from deep purple to bright cobalt-blue.

Making another early start we were soon at the top of the Chog La, which still had a good deal of snow on it. We had hoped to get a view of Makalu from here, but after waiting over an hour we gave it up as hopeless, as the clouds were getting thicker all the time. After a long and rather tiring descent we reached our camping-ground at Sakyeteng in the Kama valley. We were now almost enveloped in the clouds, and remained practically so during the whole of our stay here. Photography was extremely difficult, as it often meant waiting for a considerable time in the hope that the clouds would lift for a few moments and allow one to take a picture. After a short rest here we had intended to split up into small parties—some visiting the Popti La and lower Kama, while others explored the upper part of the valley. But owing to the bad weather and the difficulty of obtaining any coolies locally it was decided that only Captain Noel and I should go down to Kyimateng, where the Kama flows into the Arun, and from there attempt to find a way through the gorge and return to Teng by that route. The remainder of the party were to return to Teng at once, and to make arrangements for the homeward journey across Tibet pending our arrival.

Sakyeteng itself is merely a small collection of grazing huts used by

Tibetan shepherds who bring their flocks to graze at this season of the year. I imagine that the huts are unoccupied during the greater part of the year, and the position of the camp probably changes from year to year according to whether there is good grazing in the vicinity or not. It would be interesting to visit Sakyeteng in say twenty years' time, and to see whether the place was still used. It would also be a matter of great interest to find out how these temporary villages are named, as I was unable to find any one who could tell me the meaning of Sakyeteng, which might have given one a clue.

Hearing that a party of Tibetans had come from Kyimateng with supplies of salt, we went over to interview them in the hope that they might be persuaded to carry our kit for us. They agreed to come as far as Kyimateng, and with the help of a few of our own Sherpa porters we were able to make a start. Looking from the shelf of Sakyeteng, on which we were camped, one sees 2000 feet below the white thread of the Kama torrent which issues from the glaciers of Mount Everest and Makalu. The steep hillside is clothed in dense green forest at this season of the year, and the steady drizzle of rain soaks the undergrowth and drips from every leaf. A fairly good path leads down the left bank of the river as far as Chutromo, where, crossing the river, it ascends to the Popti La, a more or less frequented trade route between Nepal and Tibet. Of course this was about the worst time of the whole year in which to travel, for we could not hope for more than a few occasional hours without rain. Nor is the rain the only thing to contend with, for in a densely vegetated country like the Kama the undergrowth swarms with hungry leeches, and it is almost an impossibility to escape from their attentions.

We set off from Sakyeteng on June 27, in heavy rain. We had hoped to reach Kyimateng, but after marching some three and a half hours we met Noel's servant, who had been sent forward to buy supplies, and was now on his way back to meet us. He told us that we were not even half-way to Kyimateng, so we decided to camp for the night at the first suitable spot. A short distance beyond we came to the bridge leading across to the Popti La, at one time a much-frequented trade route between Nepal and Tibet, but now more or less discarded in favour of the more direct route straight up the Arun valley. Near the bridge is a small clearing, known as Chutromo. There were a few deserted stone huts dotted about, but they appeared not to have been occupied for some considerable time. It was this fact that first caused me to think that these small grazing villages do not exist in the same place for more than a few years. It would also seem to prove that the Popti route has fallen into disuse.

The rain had now ceased, and we made haste to pitch our tent before it should start again. A little later a somewhat watery sun made its appearance. No sooner had the sun set than thousands of tiny midges emerged, making rest almost impossible. They continued their attentions far into the night, and at last, driven to desperation, we lit a small fire of

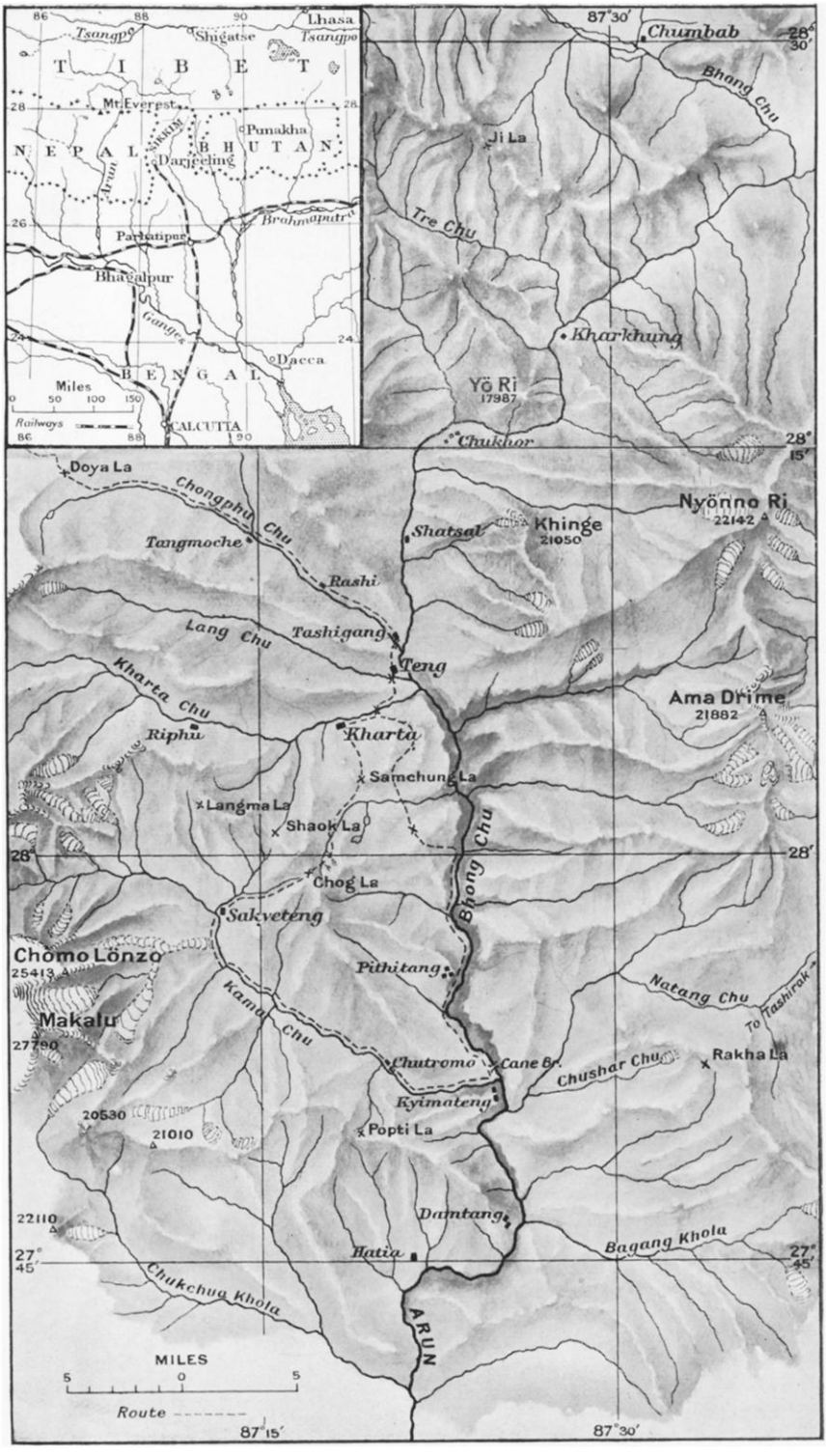
juniper twigs at the tent entrance, and took it in turns to sit up and keep it from going out.

There was no rain when we started the next morning, but thick clouds were drifting slowly up the valley. We were soon level with the Popti La. In spite of the humid atmosphere of the valley below there was still a little snow lying in the shadows on the Pass. The forest now became still more wonderful, and the trees were very much larger as we got lower down. Here and there by the bed of the river we came across delightful little glades, carpeted with moss and thick with purple irises. The path became almost invisible at times owing to the thickness of the undergrowth, and for about 2 miles was about 4 inches under water; but here the Tibetans had cut down large trees and laid them end to end along the path, which enabled one to keep fairly dry as long as one did not fall off, a not infrequent occurrence.

At last the forest ended abruptly and we were walking across grassy slopes, high above the river. Just before the end of our march we came across a party of Gurkhas, the first real Nepalese we had yet met. They had come up from Dhankuta, one of the largest villages in eastern Nepal and a few days' march down the Arun, to graze their flocks, and were halting here a few days before going on to the rich grass lands above the gorge. After a steep descent we crossed the river by a quaint little bridge, almost hidden by the overhanging trees, and commenced the short but steep climb up to the village of Kyimateng. We camped a little outside the village, which is perched on the high cliffs overlooking the junction of the Kama and Arun rivers. Looking up the Arun from our camp we could just see the tiny village of Tsanga, but the river here bends sharply to the left and is lost to view—while looking down the river we get a glimpse into the forbidden land of Nepal.

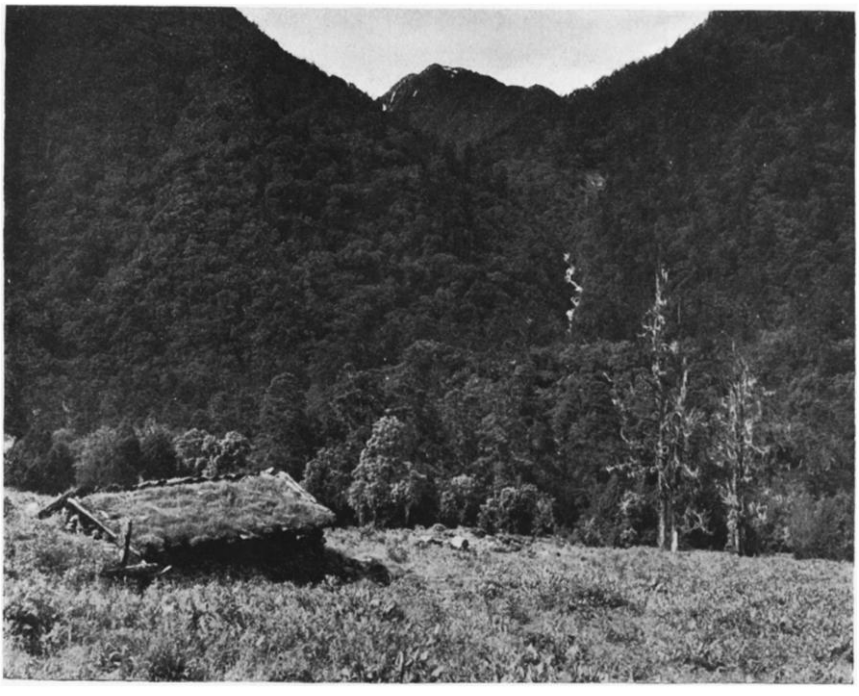
Kyimateng, though strictly speaking in Tibet, is a typical Nepalese village. The neat little houses are each surrounded by well-kept fields of Indian corn, wheat, and barley. The fields are bounded by stone walls, and each contains a small machan (light bamboo structure) from which a look-out is kept for bears at night. Kyimateng and the surrounding villages are so inaccessible that the people do not appear to come under the influence of either Tibet or Nepal, leading an independent life. The village boasts of five *Gömbos* (headmen), who all came to pay their respects early the following morning. They were extremely interested in our tents and cameras, and after a thorough inspection of everything we possessed, left in order to carry out their various duties in the village. They were unable to tell us anything of the route through the gorge, but promised to find out and also to try and get us another relay of coolies, for our original ones had not bargained to go beyond this place.

We spent the rest of the morning taking photographs in the village, and in the afternoon, as Noel was still busy with his kinema, I went to return the Gömbos' visit and to find out what our chances were of making



SKETCH-MAP OF THE GORGE OF THE ARUN (BHONG CHU)

NEPALESE AND TIBETANS FROM SAKYETENG



THE POPTI LA FROM THE NORTH BANK OF THE KAMA, 1¼ MILES BELOW CHÖTROMO

a start in the morning. To my horror I found practically the whole village drawn up outside the chief Gömbo's house. Bamboo matting had been laid down on the ground outside, and after an exchange of greetings we sat down to numerous cups of tea, fortunately without butter or salt this time. We conversed on general topics for a time, and then I thought it best to find out what arrangements had been made for us. The Gömbo at first said that there was no road through the gorge, and in any case no one was willing to go with us, as all the men in the village were occupied in the fields at this season of the year. I knew the information about there being no road to be incorrect, as the Gurkhas we met on the road the day before had told us they were on their way there. However, after a promise of double pay he guaranteed to find us coolies for the following morning.

It was necessary to pay the coolies in advance to the Gömbo, and in so doing I had an insight into the method of bookkeeping in force in this part of the world. A large board and a bag of beans were produced. The beans were laid out in rows, a row for each coolie, and a bean for each anna of the amount we agreed to pay each man. After counting the total several times the amount due from us was arrived at, and the board with the "account" on it was carefully removed inside the house. There are quite a number of Nepalese living in the village, and in consequence most of the inhabitants are bi-lingual, speaking Gurkhali, the *lingua franca* of Nepal, and Tibetan with equal fluency.

The Gömbo told me that the Popti route was being used less every year, and also that there was a fairly frequented path from Kyimateng to Tashirak, a Tibetan village some 30 miles away to the east, from which Captain Noel was turned back when he attempted to approach Mount Everest in 1913. In his paper ("A Journey to Tashirak in Southern Tibet, and the Eastern Approaches to Mount Everest," *Geogr. Journ.*, May 1919) Noel mentioned that "the approach to Mount Everest from the east would probably be across the Arun and directly west up the valleys leading to the foot of Everest." His route would undoubtedly have taken him the way we had just come, and it would have been a source of great satisfaction to him to have been able to go across to Tashirak again, and so complete his previous journey, but there was no time for this.

The road from Kyimateng, after recrossing the river and passing the fields of Lungto, which, although only a few hundred yards from Kyimateng across the river, is a purely Tibetan village and contains no Nepalese, plunges once more into the forest. The path mounts up over the cliffs, almost hiding the view of the river below, but revealing across the valley the magnificent waterfalls of Tsanga, some thousand feet in height. We continued through the forest for about three hours and then emerged on to a small alp, high above the river-bed. We found here a small matting hut, unoccupied but guarded by two savage dogs which were chained up inside. We decided to camp for the night. Strangely enough there was

no sign of water near, and we had to wait until the return of the occupants of the hut before we found out where they obtained it. Fortunately they soon returned, warned of the strangers' arrival by the savage barking of the two watch-dogs. They turned out to be Gurkhas—of the Rai tribe—and, like those we had previously met, also from Dhankuta. The old man, who must have been nearly eighty, had been, many years ago, in one of our Gurkha regiments, so we were soon talking of weapons and methods long since obsolete. He was able to tell us a certain amount about our route ahead, and said that this tract of country, although uninhabited by Tibetans, was yearly visited by large numbers of Gurkhas. The high cost of living would not appear to have penetrated as far as Nepal yet, for the old man was delighted to sell us a sheep and two chickens for the small sum of two rupees.

At the present time Nepal is an absolutely closed country, and is likely to remain always so. It is in some ways a great pity, for in this small kingdom is some of the most magnificent mountain scenery in the world, while the people certainly are amongst the most interesting. In this part of the Arun, though, it is possible to get quite a fair insight into the life of the high-living Nepalese. When one considers that they are out at day-break with their flocks and wandering about the hills until nightfall, it is no wonder that they are a hardy race. It is a common belief that all the inhabitants of Nepal, known generally as Gurkhas, are of one race. There are, as a matter of fact, at least eight distinct races, most of which speak a language totally different from the others, although all speak Khaskura, the *lingua franca* of the country.

The tribe inhabiting the north-east corner of Nepal, which adjoins the part of Tibet we are at present concerned with, differ from all the others. They are known as the Rai tribe. This tribe is again divided into a very great number of smaller tribes, and each of these sub-tribes again has a distinct language of its own. Many years ago, before Khaskura was known throughout the country, it must have been difficult for a Rai, particularly, to wander very far afield, for he would soon have been in a district where his speech was unintelligible. It would be interesting to trace the origin of all these languages. I presume that they probably have some connection with Tibetan.

In addition to the Nepalese there live, in this north-eastern corner, the Sherpas. The word Sherpa is Tibetan, and means "an easterner." They live on the highest slopes of all, speak Khaskura and Tibetan, and are extremely proud of being Nepalese subjects. They are the hardiest men of all, and provided us with the porters who did such magnificent work on Mount Everest, and without whose labours very little would have been accomplished.

Like all mountain people, the Nepalese are extremely fond of music. Their tunes are quite unlike the music of either India or Tibet; in fact, in some of the songs of eastern Nepal the scale employed is the

same as our own. They are either sung to the accompaniment of a mādal (a kind of small drum, played with the flat of the hand and the fingers) or on an instrument known as the bānsuli. This is merely a slender piece of hollow bambo with a series of little holes in it, with which the notes are formed. It gives a sound rather like a flute, but of course much thinner in tone. I will give you a few illustrations of the best-known tunes on the piano. But you must realize that it is difficult to give a true idea of Eastern music on this most Western of all instruments. You will notice in some of the tunes a striking resemblance to some of the old Scottish airs.

With regard to the words of the songs, it is not really possible to translate them into English. In most cases they are picturesque descriptions of the scenery, and give one a very good idea of the geography of the country and the customs of the people. The Arun figures in a very great number of them. We must now leave this to me most fascinating subject and continue our journey.

This part of the Arun, situated between Teng and Kyimateng, has no great waterfall, but passes through three deep gorges, one at Kyimateng, one at Teng, where, as we saw before, it enters the main range, and another between these two. For the rest it is a raging torrent running through narrow forested defiles. The remarkable drop of 4000 feet is caused by a steady fall in the bed of the river. In the centre of the gorge this fall is less pronounced and the river widens to nearly 80 yards. The average width of the river is from 30 to 40 yards, and the section of the valley is roughly V-shaped. In order to pass these gorges the path ascends and descends many thousands of feet. Looking down from the precipices one gets occasional glimpses of the torrent below, the cliffs above frequently rising to as much as 10,000 feet above the water and ending in snow-capped peaks. Here and there the promontories of the cliffs afford a wonderful panorama which rewards the exertions of the terrific ascents. But as these alternate ascents and descents are not single occurrences, but the normal nature of the track, one soon ceases to revel in the scenery and would willingly forgo these bird's-eye views from the cloud-level for the sake of a few yards' marching on the flat.

At the end of our second day's march the track appeared to come to an end. We could find no place suitable for camping, so we cut away the undergrowth from what did duty as the road. While we were doing this a swarm of bees descended on us, scattering the porters in all directions. They quickly wrapped their faces and hands in blankets, and it was some time before we could persuade them to uncover themselves. We spent the rest of the evening trying to discover the path, but were unsuccessful in finding anything. Noel and I both decided that we would not face the long and tiring journey back again the way we had come, so the only thing to be done was to make a road of our own. This we did by cutting a way through the thick jungle with kukris (a curved knife, the national weapon of the Nepalese). Fortunately the trees were mostly bamboos, so

that this was comparatively easy. We mounted over the great central gorge, and on the far side of it, dropping down to the river-bed, found a narrow strip of sand just big enough to contain our tiny camp.

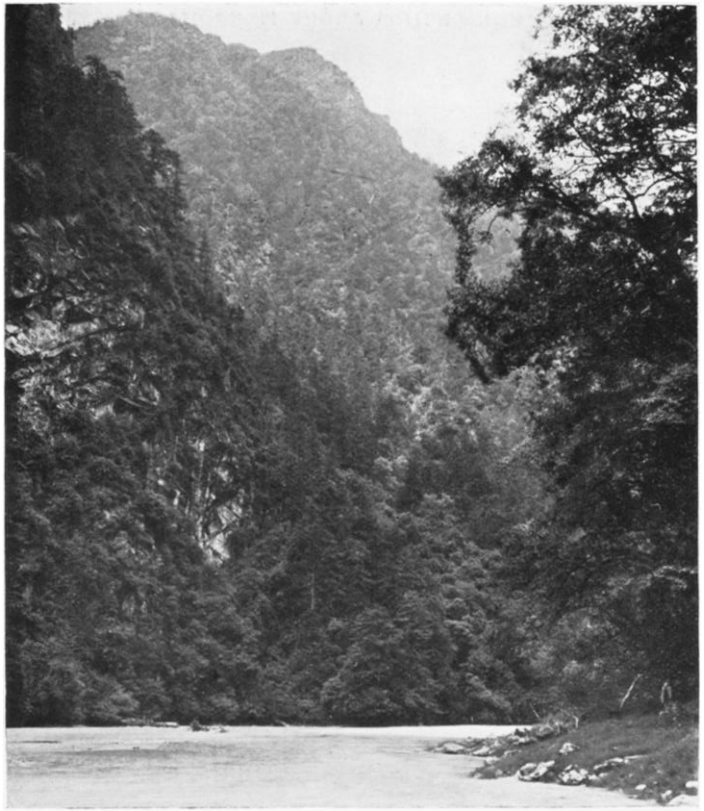
This was one of the most beautiful spots seen in the valley. Wild flowers grew here in great profusion, the most conspicuous amongst them being a giant white lily, fully 6 feet high. That evening the rain, which had been falling for most of the day, cleared, and the rising clouds revealed the luxuriant walls of the valley, which seemed to rise almost vertical above us, with black caverns beneath, where the trees trailed and projected over the water's edge.

During the fourth march we struck the track again, which is here apparently used by the Tibetans, who come down from the Teng end of the valley in order to cut wood. This path led up a side valley descending from the mountains round about the Chog La. We camped at the head of this valley, and next day crossing the Sakai Chu, a small stream which descends from the Samchung La, and the Yulök La, descended to Kharta. Here we were able to get ponies, and were soon back with the main party again. After a brief rest, during which we developed the whole of our photographs, we all set off once more on the long journey across the plains of Tibet. After an uneventful journey we reached Darjeeling again early in August. Our journeyings were now over for this year, but still we had the joys of being in a civilized country again, and were able to appreciate them all the more.

Before the paper the PRESIDENT said: The paper to-night by Captain Morris is upon the Arun gorge, and I ought perhaps to explain at once that the Arun river of which Captain Morris proposes to speak is not the river in Sussex, and the gorges of which he is going to tell us are not, therefore, some geological freak upon the estates of the Duke of Norfolk. Captain Morris, as you no doubt all know, was a member of the last Mount Everest Expedition, and to his credit lies one of the most distinctively geographical pieces of work which that Expedition accomplished. The Arun river which he is going to describe rises, as a matter of fact, on the northern side of the great Himalayan watershed, and it forces its way south through an immense gorge in that watershed. In the course of some 20 miles it drops something like 4000 feet, and Captain Morris's purpose when he undertook this piece of exploration was to ascertain, so far as possible, the nature of this remarkable gorge. He will, no doubt, be able to illustrate his remarks by a series of photographs of the wonderful scenery which he encountered in the course of his journey. I now have great pleasure in asking Captain Morris to give us his description of the gorge as he found it.

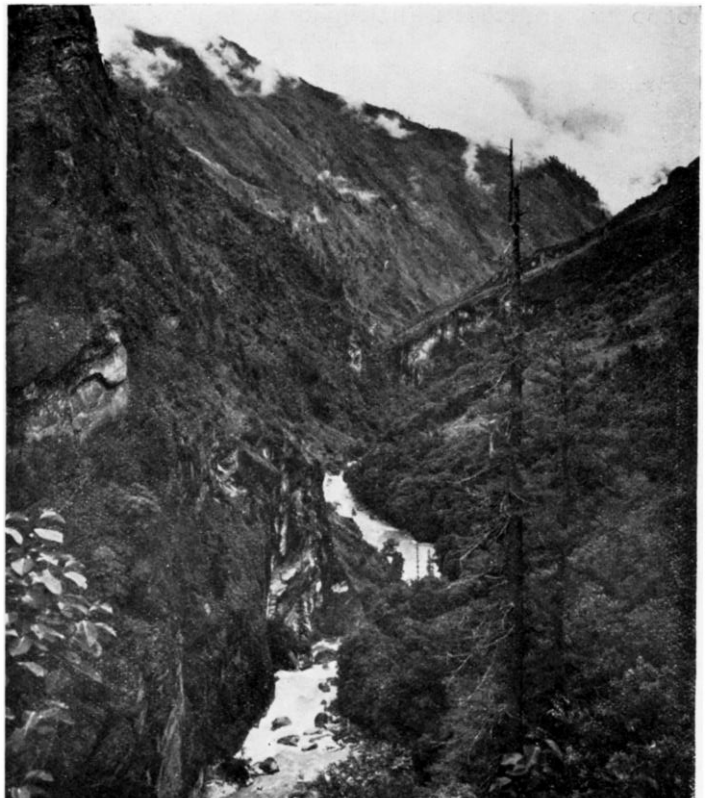
Captain Morris then read the paper printed above, and played on the piano a number of Nepalese airs which he had recorded.

The PRESIDENT: I am sure we all regret that Captain Noel, whom Captain Morris accompanied, is not able to be present this evening to add anything to what his companion has told us of their journey. But we are singularly fortunate in having with us to-night Sir Charles Bell, whose knowledge of Tibet and the adjacent regions is perhaps unrivalled. He has recently spent

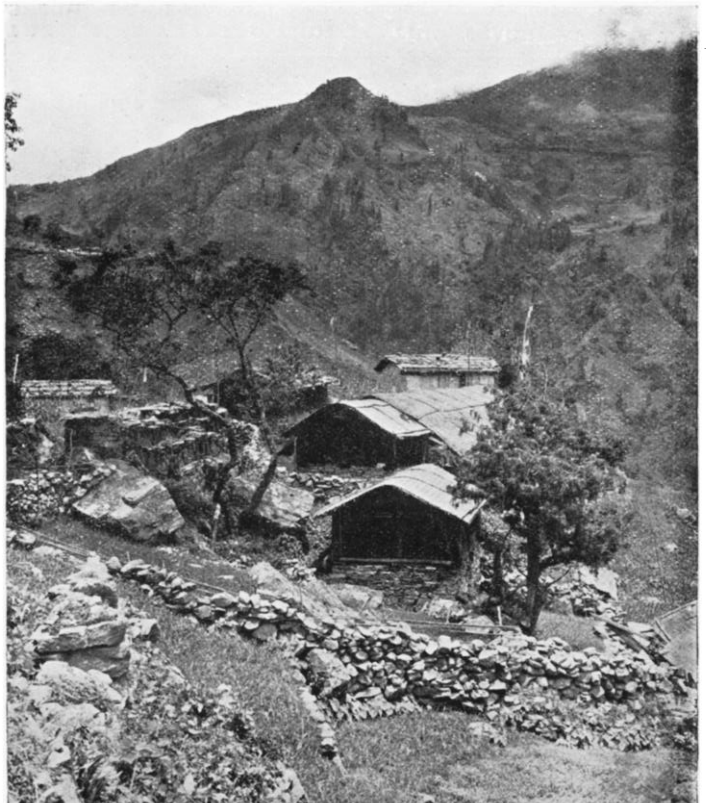


LOOKING SOUTH FROM ABOUT THE MIDDLE OF THE GORGE

THE ARUN FOREST: END OF THE TRACK AFTER THE SECOND DAY'S MARCH



LOOKING SOUTH FROM ABOUT 4 MILES NORTH OF KYIMA-TENG

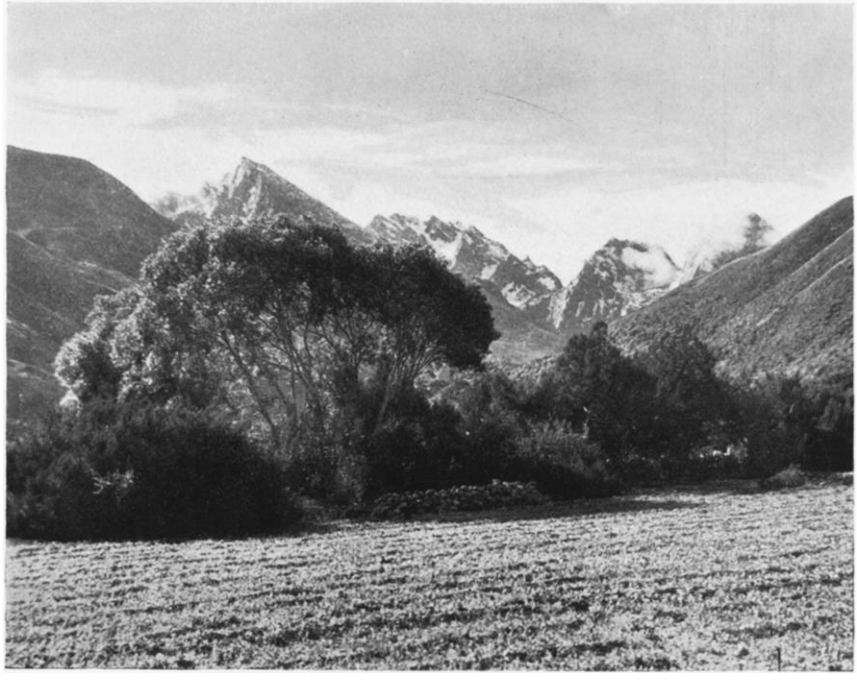


LOOKING NORTH UP THE ARUN FROM KYIMATENG: FALL OF TSANGA IN BACKGROUND

NEPALESE (RAI) FAMILY FROM DHONKUTU AT SUMMER GRAZING CAMP IN THE ARUN VALLEY

CAMP IN THE ARUN FOREST WHERE TRACK ENDED ON SECOND DAY S MARCH

ENTRANCE TO CENTRAL GORGE, LOOKING SOUTH FROM MIDWAY BETWEEN KYIMATENG AND TENG



NORTHERN ENTRANCE TO ARUN GORGE, LOOKING SOUTH FROM TENG

a prolonged period, a year or more I think, in Lhasa, and I shall be glad if he will say a few words on the subject of the paper of this evening.

Sir CHARLES BELL: The lecture that we have listened to this evening has brought back very vividly to me the twenty years or so that I spent in Tibet and on the Tibetan borderland. I propose, with your permission, to say a few words upon one or two of the many interesting points which our lecturer has raised. He was talking, among other things, about the grazing settlements. Those settlements are typical of Tibetan life, because the Tibetans at first were entirely a grazing people and at a much later period in their history took to cultivating the soil. As far as my experience went, the practice was for the settlements to move up a valley further and further as the summer advanced, usually staying about a month or six weeks in each place. They would start—in north Sikkim or in Tibet—at an elevation of some 8000 feet in March, and gradually move up to 13,000 or 14,000 feet by July. Then, as the winter approached, they would gradually come down again.

Captain Morris referred to the number of abandoned or semi-abandoned trade routes that he found. I do not wish to dogmatize, but I would suggest that this abandonment may be due, at any rate in part, to the opening of the British trade route through the Chumbi Valley. This latter attracts more and more of the Tibetan trade every year. The trade between Tibet and India passes over a frontier about 2000 miles in length, and half the total amount of trade comes down the Chumbi Valley. Gurkhas have often told me that the opening of this Chumbi Valley route has more and more destroyed their own trade routes, because the people have deserted their rough tracks and gone down this better road.

I was much interested to hear about the gigantic lily of which Captain Morris showed us such a lifelike picture, for this beautiful flower is to be found in north Sikkim also. I have seen it 6, and perhaps even 7, feet high with extraordinarily beautiful flowers which grew two and two a long way down the stalk. Another point on which I would venture to confirm what the lecturer has said is as regards the different Nepalese languages. As he has rightly told us, the different tribes of Nepal each speak a dialect of their own; and he has further informed us—a point on which I was ignorant—that the sub-tribes even have languages of their own. These languages of the different tribes of Nepal are almost the only languages outside Tibet that are closely connected with Tibetan. The language of the Khas tribe is of course derived from Sanskrit. It often happens in Tibet that after going a very short way, crossing perhaps a range of hills into another valley, one finds a marked difference in the dialect. Of course there are no railways in the country to unify these differences, and even no roads as we understand the word "road." The porters who worked for the Mount Everest Expedition, although they belong to a Tibetan tribe, yet when they go to Lhasa, are not understood by the people there. They have to find somebody to interpret for them until they can learn to speak the Lhasan dialect. So far does this difference of dialect go that the Tibetans have a proverb in which they say, "Every district its own dialect; every priest his own doctrine."

It was of especial interest to me to hear about the Arun country, in which I have never been myself, because it was in that part of the world that in the year 1792 the Chinese conducted a military expedition which has become famous in history. It was about 1791 that the Gurkhas, who had then newly come into their power in Nepal, made an expedition into Tibet and raided the highly venerated monastery of Tashi Lhunpo, the seat of the Tashi Lama

near Shigatse. The Chinese organized an expedition against them. In European books the numbers engaged in that expedition have been greatly exaggerated: nevertheless it was a considerable expedition and was composed of both Chinese and Tibetan soldiers. The expedition, as you know, marched across the whole of Tibet from the Chinese border, some 2000 miles at least, defeated the Gurkhas in several engagements, and finally dictated an ignominious peace almost within sight of Khatmandu, the capital of Nepal.

When I was in Lhasa a couple of years ago I saw various monoliths there with historical inscriptions, and among them was one which recorded the defeat of the Gurkhas. According to the usual Chinese practice, they were in high-flown style. I had a translation made, and in it I read, among other flowery praises, that the glorious army "crossed the mountains, so difficult to travel through, as if they were traversing a level plain; they crossed rivers with great waves and narrow gorges as though they were mere streams: they fought seven battles and gained seven victories."

We have had a good practical account of the Arun river from our lecturer this evening. Tibetan accounts of their own rivers are sometimes inclined to be fanciful. The Tibetans believe that four large rivers rise from that mountain in western Tibet which the Indians know as Kailas and which the Tibetans know as Kang Rimpo-she, "The Snow of Great Price." Of those rivers we are told that "The first proceeds from the mouth of a horse and flows through Tibet, the land of horses; the second comes out of the mouth of a lion and flows through Ladakh, where men have the strength of lions; the third issues from the mouth of an elephant and flows through Nepal, the land of elephants; the fourth proceeds from the mouth of a peacock and flows through China, the land of beautiful women." Whatever the other rivers may have achieved, I cannot help feeling admiration for the river that flows through China, because, in order to reach China at all, it would have to climb over or burrow under three of the most substantial mountain masses in Asia.

The PRESIDENT: Major Morshead, who was a member of the Mount Everest Expedition of 1921 and 1922, is also present, and in asking him to say a few words I would at the same time congratulate him upon his recovery from the severe attack of frostbite from which he suffered.

Major MORSHEAD: I am afraid I have nothing to add to the interesting lecture we have had to-night.

The PRESIDENT: Then I ask Prof. Turner, the Sanskrit scholar, who has recently made an extensive study of Nepalese languages, whether he would add a word or two.

Prof. TURNER: I feel, after you have heard Captain Morris and Sir Charles Bell speak of this country of Tibet where it neighbours Nepal, that I have no business at all to address you; for the nearest I have been to Tibet is but to see its snows from India, and the furthest that I have been in Nepal is but a few yards when I walked along the ridge which separates British India from Nepal on the Darjeeling side, and where every now and then the path passes to the Nepal side of the boundary pillars. But as I listened to Captain Morris's rendering of those Rāi songs I felt I had but to shut my eyes and I was back again on that mountain path, the mists surrounding me, with now and then a clearance through which I could look down into one of those mysterious valleys of an almost unknown land, while high above, coming down the path from some distant valley on a four or five days' march to the nearest market, there was a party of Rāini girls singing such songs as Captain Morris gave us.

There is one point I might elaborate which both Captain Morris and Sir

Charles Bell spoke of: the history of the languages spoken in that part of the world. They both mentioned languages in the plural and I repeat it, for, as we were told, the languages spoken there are almost innumerable. Not only are conditions so different from what we are accustomed to in Western Europe where the same language may be spoken by millions of people in more or less the same form, whereas there there are a great many languages differing, as we have been told, from valley to valley or even from village to village, but the matter is sometimes even more complicated, and where the speakers of one language have migrated, for some reason or other, you may to-day find living in the same village, side by side, families speaking languages completely unintelligible to each other. So that a household may have one language as its mother tongue, while the next household has another language as its mother tongue, and neither could understand the other unless they had a third language in common. And if you will permit me for a moment to take up your time I should like to tell you how it came about that they have this third language in common.

All these multitudinous languages—and the Linguistic Survey of India speaks of at least twenty different languages in Nepal alone, all mutually unintelligible—which are spoken from the far north-west in Baltistan to the far south-east in Burma, belong to a family commonly called the Tibeto-Burman. They are connected, on the one hand, with the Tai languages to which belongs Siamese, and, on the other, with Chinese, and the whole are sometimes grouped under the name of Mongolian or Indo-Chinese. The Mongolians coming from the north and pressing down into the more fertile valleys on the southern face of the Himalayas, spoke probably a language which was sensibly the same. But, as the pictures that you have seen to-night have shown you, the country is such that communication is difficult in the extreme, even if, unlike the Tibetan governor, you are willing to move on your feet, and at the same time there has been no political power stretching over that whole extent of country which would hold a community together. The result was that in course of time this extraordinary diversity of language developed, just as in Europe the Latin language, which was spoken over the whole of the Roman Empire, diverged with the break-up of that empire into the various Romance languages of to-day. Such a state of affairs in which the people of one valley speak a different language from the people of the next and two households in the same village may have different languages is not likely to be stable when it comes into contact with a higher civilization. And what we can observe to-day is a process which has been going on for a considerable number of centuries. The Mongolians pressed forward on to the southern slopes of the Himalayas from the north, and at the same time there were peoples moving into and along the mountains from India. These people whose languages are spoken over the whole of North and Central India entered India from the west, and their language, called Sanskrit, is of the same stock, the same family, as our own or as Latin and Greek, and very nearly the whole of the population of Northern and Central India now speak languages descended from this one language, Sanskrit. From the earliest times after their arrival in India these people, called the Aryans, tended to press up into the mountains up the lower slopes of the Himalaya, and at a comparatively early period, certainly by 600 A.D. and probably several centuries earlier, they had already reached this mountain land of Nepal. They bear the name of Khas, a word which you can find in the names of various tribes and castes along all the southern slopes of the Himalaya, and which occurs again probably in the name of the country Kashmir,

and possibly of Kashgar; Pliny mentions it in his geography as the name of a tribe in northern India, the Cesi. Those people speak an Aryan language descended from Sanskrit, and that language they call Khaskurā, the language of the Khas; or Parbatiyā, the language of the mountains; or Gorkhāli Bhāshā, the language of the Gurkhas.

About the middle of the eighteenth century a Khas tribe speaking this Aryan language, who were settled round the little town of Gorkhā in Nepal, gained under their leader, Prithivā Narāyan Shah, the ascendancy in the valley of Nepal where lies Khatmandu, and from the valley of Nepal they spread their power over the whole of what is now Nepal, and at one time far exceeded its present boundaries until their power clashed with that of the Honourable East India Company. Their language, an Aryan language descended from Sanskrit, being the language of the ruling caste and of government in Nepal, has tended, and is still tending, to oust all the various disjunct Mongolian dialects and to become among the people the common means of communication, so that now where you have one household speaking a language quite unintelligible to its next-door neighbour, they both have to learn Khaskurā in order to communicate with each other. This is the language, often I must confess in a very mutilated form, which is used as the general means of communication in the Gurkha battalions of the Indian Army.

I think possibly a future historian may draw attention to this one small point, that here in India we have been in close alliance for a century with a country with which our borders march for over 700 miles, from which we have drawn many thousands of men to serve in our Indian Army, and yet, if you will forgive this anti-climax, of whose language we have never yet produced a dictionary. It is true that some vocabularies have been made, but nothing like an attempt at a complete dictionary of the language has yet been published, and the reason of that is the reason of so many other of our present difficulties, the lack of funds.

I do not know, my lord, whether before the Royal Geographical Society I may turn from this short excursus on the language of the people of whom we have been hearing to-night to say a few words on one of their other activities. Captain Morris has told us of the people of Nepal, and he has shown us such very charming photographs of some of the individuals, that I feel I may be forgiven. We have heard to-night casual mention of the Gurkha battalions of the Indian Army. I feel that the British public at large have no clear realization of what the inhabitants of that little strip of country—it looks little enough on the map though it is 700 miles long—have done for us in the last few years. The population of Nepal is estimated to be not more than 3,000,000 people, and of that probably less than half belong to the fighting tribes. And yet during the years of the war 200,000 men were recruited from that country to help us; 55,000 were actually enlisted in the Gurkha battalions of the Indian Army. We had a certain ideal, perhaps, before us, and they too had their ideal—not the same as ours: it was the ideal of being true to their salt. When General Bruce came back from the Mount Everest Expedition he opened in Darjeeling a memorial to the Gurkhas who had fallen in the war. It was a Rest House for those widows and orphans who come down from the mountains to receive their pensions from the British Government year by year. In the middle of the courtyard there is a pillar on which is this inscription in Khaskurā: "To all the Gurkhas who in England's Great War between 1914 and 1918 passed to the other world this dharmsala is built." The bodies of those who thus passed over fell in many parts of the world. Gurkha soldiers were to be found

cheerfully enduring tropic heat or the cold of the northern winters or the thirst of sandy deserts. Almost wherever there was a theatre of war Gurkhas were to be found, and everywhere they added only lustre to their name for high courage. Gurkhas helped to hold the sodden trenches of France in that first terrible winter and during the succeeding summer. Their graves are thick on the Peninsula, in Sinai, and on the stony hills of Judæa. They fell in the forests of Africa and on the plains of Tigris and Euphrates, and even among the wild mountains that border on the Caspian Sea. And to those who know, when they see the map of that country which we have had before us to-night, of Nepal, there must always recur the thought of what the people of that country have done for us.

The PRESIDENT: In conclusion, I would ask Major Wheeler, a member of the Mount Everest Expedition of 1921, who did the photographic survey of the country, if he would say a word.

Major WHEELER: I am afraid I have very little to say with regard to the paper we have heard to-night; although I was in Tibet in 1921, I looked at the the Arun gorge only from the village of Teng, which is quite a long way off. I was, however, very much interested to hear Captain Morris's description of the Expedition up the gorge, and to see his beautiful pictures. There is only one point in his paper that I would like to refer to: that is his remark as to having to wait sometimes an hour before taking one snap-shot. From my own experience I think that he was extremely lucky, for I found many times that I had to sit on the top of a mountain for nearly a whole day in order to get one picture!

The PRESIDENT: In thanking Captain Morris for his lecture this evening I would venture to congratulate him upon the success of the experiment of interposing a brief musical interlude in a geographical discourse. I was particularly interested in the tunes of the folk songs which he gave us, because I always found an immense attraction myself in the music of the people of the eastern Himalayas, and I can certainly confirm what Captain Morris said as to the curious resemblance which the music of these mountain peoples often bears to the music of our own mountain peoples in the United Kingdom, the people of Scotland. Not only do the tunes bear a strong resemblance to many Scottish airs, but the people of Sikkim, at any rate, possess instruments which recall to any Scotchman very vividly his own national form of music. They have a combination of two instruments, one of which produces the exact sound of the drone of the bagpipe, and when that is combined with a particular form of horn it is almost impossible, if you shut your eyes, to doubt that you are listening to the familiar drone of the pipes. So much so that one of the constant companions of my rambles in those parts of the world, a Scotchman and an elder of a Scottish kirk who figures under that title in a recent publication of my own, was on one occasion misled into believing that the inhabitants of a certain village, out of courtesy to our nationality (which was probably quite unknown to them), were regaling us with a rendering of "Scotland for Ever."

In bringing this Session to a close may I venture, on your behalf, to assure Captain Morris that the concluding lecture of a Session during which we have had many interesting accounts of a number of out-of-the-way parts of the world, has been by no means the least interesting.

seems to merit the attention of students of Chinese history. To the south-west of Kuling stands a ruined tower, commonly known as the Broken Pagoda, belonging to the Temple of the Heavenly Pond. This pagoda was built during the Sung dynasty (960–1280 A.D.). Its present condition is due largely to its having been plundered by the T'ai Ping rebels. Ancient stone buildings of this type are apparently rare in China, and its architectural style is not that usually associated with pagodas.

The second example exhibits even greater divergences from " typical " Chinese architecture. This is the " Drum Tower," Taipingkung, on the plains north of Kuling. The site of this temple has a history running back beyond the ninth century A.D. The buildings were destroyed during the Mongol dynasty (*circa* 1350), but in later years Taipingkung again became important. During the reign of the Ming Emperor, Chia Ching (1522–66), disputes between the neighbouring provinces were settled here. It is suggested that this fact gave the temple its name, which means " Palace of Supreme Peace." Two towers only remain, one of which is illustrated opposite. They are approximately 40 feet high ; each has an exterior staircase, and is loopholed. The apparently alien elements in the architecture of the Drum Tower seem to deserve study.

KISHEN SINGH AND THE INDIAN EXPLORERS

Major Kenneth Mason, M.C., R.E., Survey of India

PANDIT KISHEN SINGH, or Krishna (" A-K " of the Survey Records), the last survivor of the old Indian explorers, died in February 1921, and his death marks the close of a romantic chapter of the Survey of India and of Asiatic exploration. The occasion seems a a fitting one to place on record a brief review of his services to geography and to summarize shortly the advance of knowledge gained by him and his contemporaries.

Born in Milam, in district Kumaon, in the early 'forties of last century, he came from a family respected and esteemed and one which has since added more to our knowledge of the geography of Asia than any other. His father, Devi (or Deb) Singh, and his uncle, Bir Singh, both sons of Dhamu, had been responsible for the rescue of Moorcroft and Hearsey, when, under the assumed names of Mayapuri and Hargiri and disguised as fakirs, they visited the Hundes and Gartok in 1812. The two adventurers had been taken prisoners by the Tibetans and detained at Daba Dzong, some 80 miles north-west of Lake Manasarowar, from which plight they were released by the interposition and on the security of Devi and Bir Singh. Two certificates signed by Moorcroft and Hearsey are extant, dated " Northern foot of the Himachal Mountains near Daba

in Chinese Tartary, August 25th 1812," testifying to the worth of their deliverers.

The next record of the family exists in the narrative of the Schlagintweits published after their scientific mission to High Asia in 1854–58. These travellers employed as interpreter Devi Singh's son Mani, who "had once been engaged by the Stracheys during their travels in Tibet," and Nain Singh, a relative of Mani, "a well-disposed and intelligent native." These two men afterwards became the first two "pandits" of the Survey of India.

The idea of employing selected Indians for service across the frontiers of India originated in the mind of Captain T. G. Montgomerie in 1861, towards the close of the Kashmir work. He realized that the regular survey in the mountainous borderland had nearly reached the limits of its possibilities. The murder of Adolphe de Schlagintweit at Kashgar in 1857: the unsettled conditions of the whole of Chinese Turkistan, ending in the outbreak of the Tungan rebellion in 1863: the aloofness and seclusion of Tibet: the fanaticism of the Indus valley tribes and their active hostility to Europeans: the predatory instincts of the robber states of Hunza and Nagar: these considerations impressed Montgomerie with the desirability of seeking other methods for the extension of our geographical knowledge to the regions concerned.

It should be remembered that our transfrontier maps were almost a blank. Even within the border, the survey of certain areas along the Indus had been abandoned. Europeans could not travel in these parts without certainty of detection, and the Government of India forbade such enterprises. Disobedience to these orders occurred in one recorded instance, 1865, when Mr. Johnson made his famous visit to the rebel ruler of Khotan. In view of the success of his journey he received only a gentle rebuke, but the orders were repeated discountenancing such enterprises.

Montgomerie thought that by selecting and training Indians with care, and disguising them if necessary, results of great geographical importance would be attained. On the west, from the Black Mountain area in the south to a point near Bunji in the north, the Indus was unvisited; Gilgit, Chitral, and Chilas were unexplored; Godwin-Austen's plane-table of 1861 showed the "supposed course of the Hunzay river" as flowing due east to west, "but which may have a long branch further north"; Wood's journey to Lake Victoria in 1838 was almost the sole modern source of information concerning the Pamirs. The position assigned by the Russians to Kashgar was at variance with that given by the Schlagintweits, while Montgomerie believed that the position of Yarkand as shown by the latter was 200 miles in error. Khotan had not been visited by any European since Benedict Goëz (1604). Except for the journeys of Bogle, Turner, Manning, and the Abbé Huc, Central Tibet was unknown and entirely unmapped. The position of Lhasa

was almost conjectural; it was shrouded in mystery and romance. One point only of the Tsanpo had been roughly charted; the main feeder of the upper Indus was denied by many geographers, and except for a few jottings from the diary of Moorcroft, from the observations of the Stracheys, the Schlagintweits, Major Alexander Cunningham, and Dr. Thomson, Western Tibet also was a land of seclusion and exclusivism.

These problems Montgomerie determined to attack, and thanks to his success the veil was lifted. His proposal received the warm support of Major (afterwards General) J. T. Walker, Superintendent of the Great Trigonometrical Survey. On 8 May 1862 he forwarded a concrete plan to the Government of India asking for Rs.1000 with which to commence the training of explorers. Men were to be carefully selected and engaged on a salary of from Rs.16 to Rs.20 per month, and money was to be advanced with which to buy medicines and merchandise. Their subsequent reward was to depend upon the value of the work accomplished. They were to choose their own disguise, should they prefer to conceal their identity,* and their instructions were to be interpreted broadly and carried out according to the circumstances in which they were placed.

It was Walker who selected the Bhotias of Milam. Nain Singh, "the Pandit," and his cousin Mani Singh (G-M), on the recommendation of Major Smyth of the Education Department, were engaged and sent to Dehra Dun. Trained first by Walker himself and afterwards by Montgomerie, they showed zeal, interest, and aptitude, rapidly learned the use of the sextant and compass, and recognized the most important stars. Towards the end of 1864 the experiment was put into practice. A first attempt to penetrate Tibet from Kumaon was unsuccessful, but the following year a second effort was made *viâ* Nepal. Here, too, difficulties were encountered, and Nain Singh, having parted with his money to a trader who promised to take him into Lhasa, was deserted by the trader and left almost penniless. The two explorers then separated and tried to get through independently. Nain Singh alone was successful. In disguise he reached Tradom on the Tsanpo and joined a caravan making its way from Ladakh to Lhasa. He reached the latter place on 10 January 1866, and after earning a scanty livelihood as a teacher of accounts he eventually returned by the same route to Tradom, whence he regained India by Lake Manasarowar. His cousin failed to penetrate Tibet and returned from Nepal, afterwards making a route traverse to Gartok and back, to recover possession of the articles deposited by Nain Singh with the caravan leader as security for money borrowed.†

* The standing orders of the Emperor of China were to the effect that "no Moghul, Hindustani, Pathan or Feringhi" should be admitted into Tibet.

† General Report of the Survey of India, 1866–67, reprinted in *Records of the Survey of India*, 1915, vol. 8, part i. In Montgomerie's report the two explorers are alluded to as brothers.

The results of this successful journey fastened the attention of the authorities on the possibilities of such enterprises. The southern trade-route had been mapped in some detail. For nearly 600 miles the course of " the great river of Tibet " had been traced, and a valuable report on it had been secured. Strong reasons had been collected for believing it to be the upper course of the Brahmaputra, a fact which was afterwards doubted but subsequently proved. Stories of goldfields had been told both in Lhasa and Gartok, a mass of information regarding places and routes in Tibet, previously entirely unknown, promised a valuable return for further efforts. The journey merited the applause of the geographers of Europe, and Nain Singh, in addition to receiving a reward from the Government of India, was awarded a gold watch by the Royal Geographical Society, a present which was unfortunately stolen from him subsequently by one of his own pupils.

As may be imagined, further proposals by Montgomerie and Walker for an extension of the work were approved by the Government of India. A third pandit, Kalian Singh, G-K,* a brother † of Nain Singh, was entertained, and preparations were made early in 1867 to explore and clear up doubtful points in the headwaters of the Sutlej, to connect the map of this area with the easternmost part of the regular survey of Ladakh completed in 1864, to investigate the controversial question of the existence of the eastern branch of the Indus, and to explore the gold-mining district reported east and north-east of Gartok.

The three pandits on this occasion assumed the guise of Bashahri traders. In some ways this was unfortunate as, unknown to them, during the previous year smallpox had been introduced into Tibet by these people, and strict orders had been issued by the Lhasa authorities against their admission. The party therefore not unnaturally met with great suspicion, and at one time it seemed certain that the enterprise must fail. With great perseverance the pandits kept on and eventually carried out the tasks allotted to them. Thokjalung, the principal gold-field, was visited; both the main upper branches of the Indus for the greater portions of their lengths were mapped; the Sutlej course was traced from Totling to Shipki; 18,000 square miles of country, founded on 850 miles of closed route survey and controlled by latitude observations at seventy-five different points, were reconnoitred and sketched;

* For obvious reasons all explorers during their employment were given pseudonyms. Generally initials alone were used, and these initials were often combined by inverting the order of the first and last letters or of the initials of the man's name; thus *K*alian Sing(h) was known as G-K, Kishen Singh or *K*rishn*a*, the name under which he was entertained, became A-K, *A*bdul Subha*n* N-A, *S*arat *C*handra *D*as D-C-S, etc. In the case of a few they merely became known by titles, *i.e.* Nain Singh was always " The Pandit "; Ata Mahomed " The Mullah "; Mirza Shujah " The Mirza," etc.

† Kalian Singh is specifically called a " brother of Nain Singh and a cousin of Kishen Singh " in a document dated 1883.

the position of Gartok as found by the previous expedition was checked.*

Nain Singh required a rest after this journey ; he had been travelling and exploring under severe conditions for three years. It was therefore decided to utilize his services for the training of new explorers. Among those engaged within the next year or two was Kishen Singh, known as Krishna in the earlier documents of the Survey, the son of Devi Singh, a Milamwal and first cousin to Nain Singh.† A-K, as he was known in Tibetan exploration, was destined afterwards to attain almost greater fame than his master, the Pandit. His first exploration in 1869, during which his capabilities were tested, included a route traverse from Kathai Ghat up the Karnali *viâ* Khojarnath, thence to Rakas Tal, from which point he made his way to Milam. ‡

Meanwhile the other pandits were engaged in extending the earlier explorations of Nain Singh. The third pandit, Kalian Singh, G-K, in 1868 made a route traverse from Spiti across unknown Chumurti and Guge, the westernmost districts of Tibet, and, crossing the Indus at Tashigong, reached the holy city of Rudok, a place almost if not quite as secluded as Lhasa itself. Again posing as a Bashahri trader he attempted to reach Lhasa *viâ* the goldfields, but was stopped at Shigatse and sent back. By great good fortune he was released at Tradom and made his way back to India *viâ* Muktinath and through Nepal, effecting a useful connection and check on the first visit of Nain Singh. §

In the same year the first attempt was made to explore the Mount Everest group. The name of the explorer concerned seems to have been lost, but it appears that he penetrated the country north of the mountain and was stopped and sent back by Tibetans on the Tingri Maidan. ‖ In 1871–72 Hari Ram (M-H), struck north from Darjeeling and reached Shigatse; thence he traversed the Tingri Maidan, crossed the axis of the great range 60 miles west of Mount Everest by the Bhotia

* General Report, Survey of India, 1867–68, reprinted in *Records of the Survey of India*, 1915, vol. 8, part i.

† Nain Singh is sometimes spoken of as the uncle of Kishen Singh, and I am told by some of the present members of the Survey of India that this is a fact. I have consulted as many contemporary documents as possible ; I can find one reference to their relationship as cousins and frequent notices to their fathers Devi Singh and Bir Singh being brothers and the sons of Dhamu. See also note † to page 432. The first reference to Kishen Singh as the nephew of Nain Singh appears since 1900.

‡ No report of this journey was published. The route survey was incorporated in the Survey of India Transfrontier Map No. 9 (Old Series).

§ General Report, Survey of India, 1868–69, reprinted in *Records of the Survey of India*, 1915, vol. 8, part i.

‖ The explorer Hari Ram, M-H, sometimes referred to as No. 9, commenced work in 1868, and it is probable that it was he who reached the Tingri Maidan in that year, since his subsequent operations were all in this area. No account of the journey was published, but the results of it were incorporated in the Survey of India Transfrontier Map No. 9 (Old Series).

Kosi defile and reached Katmandu. Turning eastwards he traced the course of the Sun Kosi for some 80 miles, and regained Darjeeling. This exploration was particularly valuable, for it gave a rough indication of the Indo-Tibetan watershed and proved that it lay north of the great peaks. A complete circuit of the Mount Everest group was made and much interesting information was gained of the country from native sources, but the explorer was so hemmed in by mountains that he never was certain that he viewed that giant peak itself.*

Though the Indian explorers of the time became collectively known as "the pandits," it must not be supposed that all were Hindus; nor was Tibet alone the object of their operations. The work accomplished by the Mohammedan explorers in the far North-West was equally valuable but has become less generally known. The same mystery did not shroud those turbulent districts; the same interest from a popular standpoint was not aroused. Nevertheless risks as great as those in Tibet were taken and results of great geographical importance were achieved.

First among these explorers was Mirza Shuja, "the Mirza," who commenced work in 1868. A native of Persia, he had as a lad served under Major Eldred Pottinger during the famous defence of Herat. Pottinger brought him to Kabul, where he was educated in English by Colin Mackenzie. His knowledge of Pushtu and Persian and the training he received in surveying rendered him a very fit person for exploratory work, and on the recommendation of Walker and Montgomerie, the Government "was pleased to sanction his entertainment for employment in the geographical operations in progress on the Kashmir frontier." Actually he was not so employed, and having returned to Kabul on leave, he became for a time tutor to the sons of Sher Ali, the Amir of Afghanistan. In 1868, however, after the temporary dethronement of his patron, he again rejoined the Survey of India, and was despatched on a long journey of exploration through northern Afghanistan and across the Pamirs to Kashgar.† In 1872–73, while on a second expedition, both he and his son-in-law were treacherously murdered while asleep, by their guides, somewhere between Maimana and Bokhara, after reaching the former place safely from Herat.

Perhaps from a geographical point of view, the most interesting of the Mohammedan explorations on the North-West were those of Ata Mahomed, "the Mullah." A well-educated native of Peshawur, versed in Arabic, he was the brother of an Indian sapper murdered in Swat in 1869. His first journey of exploration, 1873–74, from Jalalabad through Dir, Chitral, Mastuj, and by the Baroghil pass to Tashkurghan and

* General Report, Survey of India, 1871–72, reprinted in *Records of the Survey of India*, 1915, vol. 8, part i.

† General Report, Survey of India, 1869–70; *Journal of the Royal Geographical Society*, vol. 41, 1871.

Yarkand,* led to his selection for the investigation of the unknown course of the Indus. In the *rôle* of a mullah, in 1876 he followed the wild gorges of the Indus, tracing its course up from the plains to Bunji, after which he explored Yasin (General Report, Survey of India, 1876–77). Two years afterwards he assumed the guise of a timber merchant of Swat, penetrated and explored that country, whence he crossed the Palesar pass and traced the Kandia tributary of the Indus to its confluence with the latter river near its great southerly bend, connecting his work to that already accomplished by him (General Report, Survey of India, 1878–79). To this day our maps of this district are almost entirely dependent on his journeys.

One other Mohammedan explorer became famous further afield. Haider Shah, "the Havildar," commenced his survey career in August 1870 with a journey from Peshawur, whence he reached Faizabad by way of Dir and Chitral (General Report, Survey of India, 1870–71). He was again employed in 1872 on a route survey from Kabul to Bokhara,† but as in the case of most explorers, his third and last was his most important contribution to geography. Starting from Kabul in November 1873, he travelled to Faizabad by a new route and thence reached Kulab by Rustak and Samti. From Kulab he journeyed to Yazghulam on the Oxus between Darwaz and Roshan;‡ thence he returned to Kulab and carried out further important route traverses, returning to Kabul on 28 December 1874.§

It is perhaps unnecessary to detail the journeys of all the explorers during this period. Some were naturally more valuable and successful than others, and covered more interesting ground. Sometimes the explorer travelled as a trader, sometimes as a mullah, or a lama counting his beads—and incidentally his paces—with his rosary as he marched.‖ At the end of a hundred paces the prayer-wheel was turned, the prayer—and the distance—was recorded. Within the prayer-wheel were secreted records of the pandit's observations; sometimes a small compass was hidden in the top. The explorers invariably carried medicines and drugs, and though none had taken a doctor's degree, in at least one recorded instance the successful treatment of an official's wife enabled the surprised pandit to overcome opposition, to allay suspicion, and to proceed. Sometimes expeditions failed or led to small results; the explorer was robbed or turned back; occasionally he was murdered.

* Report on Trans-Himalayan Exploration during 1873–4–5, drawn up by Captain H. Trotter, R.E., 1876.

† No account of this journey appears to have been published.

‡ This explorer's work narrowly missed a connection with that of Abdul Subhan during the Forsyth Mission (see on).

§ Report on Trans-Himalayan Explorations during 1873-4-5, drawn up by Captain H. Trotter, R.E., 1876.

‖ The Tibetan rosary has 108 beads; that of the pandit explorers was made up of 100 beads for obvious reasons.

The period is one of great perseverance as the interior of Asia unfolded her hidden secrets.

From 1870 onwards these journeys were carried on in increasing numbers, and a few of the more notable ones only will now be mentioned.

Kishen Singh's work, which was almost entirely in Chinese Turkistan and Tibet, began in 1869; his journey in that year has been briefly referred to before. In 1871, with a young Tibetan and three assistants, ostensibly engaged in trade, but all trained in reconnaissance survey, he reached Shigatse, whence he journeyed northwards and reached Tengri-nor, the great lake 70 miles north of Lhasa, on 21 January 1872, and made a complete circuit of it. Shortly afterwards the party was attacked by about sixty armed and mounted robbers, who plundered them of nearly everything they possessed. Further exploration to the north was impossible, and it was only with great difficulty that Kishen Singh reached Lhasa. By pledging his instruments he had to return to Gartok, whence he reached India.*

In 1873 the Government of India despatched a mission to Yarkand under the command of Sir Douglas Forsyth. Captain H. Trotter, R.E., in charge of the survey detachment, took with him Nain Singh, Kalian Singh, Kishen Singh, a sub-surveyor Abdul Subhan, and two assistants.† Route traverses, controlled by theodolite and sextant latitudes, were made from Leh across the Lingzithang plains to Yarkand and on to Kashgar, and a variety of astronomical observations were taken at these places. Nain Singh and Kalian Singh remained at Yarkand; Kishen Singh and Abdul Subhan both proceeded to Kashgar, and with Colonel Gordon's party effected route traverses to the Pamirs and back. "The Munshi," being a Mohammedan, accompanied the party to Kala Panja, whence he was despatched to follow the course of the Oxus. He traced the great river for some 60 miles to its right-angle bend near Ishkashim, and then followed it northwards through the totally unknown districts of Shighnan and Roshan to Kala Wamar, near the confluence of the Murghab and Oxus.‡

Kishen Singh's most valuable work on this mission was accomplished on the return journey. Detached at Yarkand, he made an accurate route traverse *viâ* Karghalik, Guma, Polur, and the headwaters of the Keriya river to the Pangkong lake and Tankse in Ladakh, where he closed his work on a point already fixed.§ The results of this journey proved the surprising accuracy of the traverse method adopted by Montgomerie;

* General Report, Survey of India, 1873–74; reprinted in *Records of the Survey of India*, 1915, vol. 8, part i.

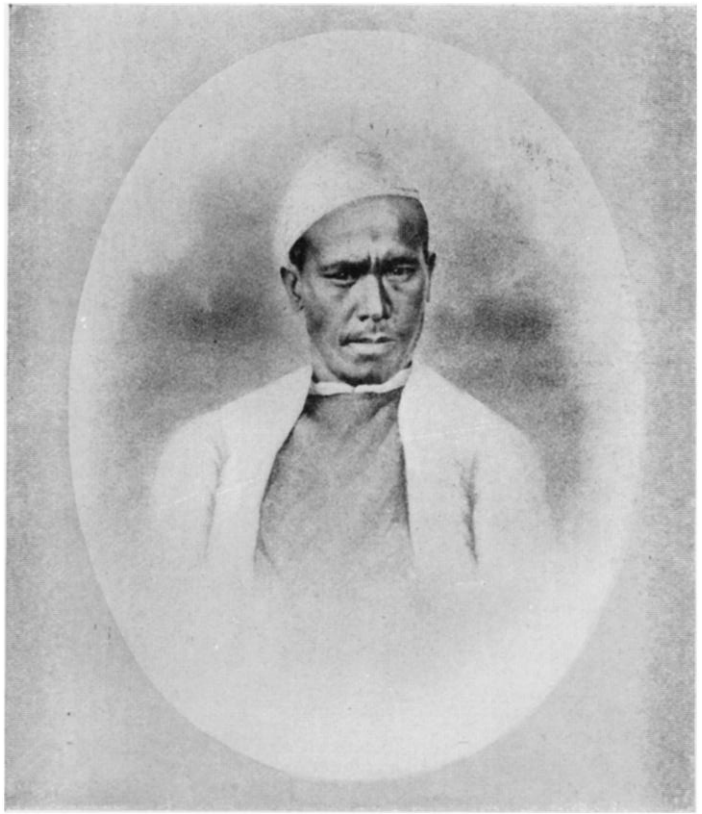
† Abdul Subhan was not specially engaged as an explorer; but he is sometimes referred to in the records of trans-frontier exploration as "the Munshi."

‡ 'Report of a Mission to Yarkand in 1873 under the command of Sir T. D. Forsyth' (Calcutta, 1875), chap. vii.

§ 'Account of Survey Operations in Eastern Turkistan, 1873–74,' by Captain H. Trotter; reprinted in *Records of the Survey of India*, 1915, vol. 8, part i.

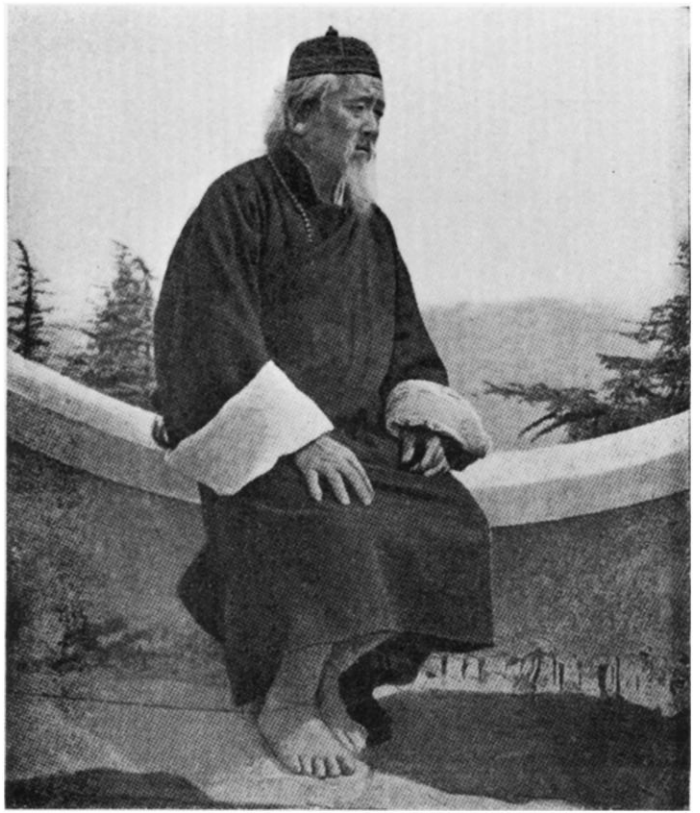
KISHEN SINGH, "A—K"

[*From* '*Records, Survey of India*,' *vol.* 8, *Pt.* 1.



NAIN SINGH, C.I.E., "PANDIT A"

[*From 'Records, Survey of India,' vol.* 8, *Pt.* 2.



KINTHUP

[*From 'Records, Survey of India,' vol.* 4.

Khotan at last became correctly plotted, Johnson's position being found to be at fault; and it is noteworthy of Trotter's confidence in Kishen Singh that he accepted his traverse value for the longitude of Yarkand in preference to that obtained by chronometric differences or lunar zenith distances.* Had still more reliance been placed upon the evidence collected by him, the map of the headwaters of the Yurungkash would not have remained incorrect for nearly fifty years.

Abdul Subhan, "the Munshi," was afterwards sent on a further journey of exploration. He completely disappeared, and except for a rough note of 1884 to the effect that he is "understood to be in the services of the Amir of Kabul," I can find no further mention of him in any document.

Previous to the second Yarkand Mission of 1873, Nain Singh had been fully occupied in the training of Indian explorers. He had attained a certain amount of notoriety, and for this reason it was difficult to employ him without raising suspicion. On his return from that mission in 1874, he volunteered for fresh work in Tibet. With some difficulty he crossed the frontier disguised as a lama and succeeded in traversing the whole length of Tibet to Lhasa by the great northern road. Fear of discovery at the holy city led him to curtail his visit. His records were sent back by his assistants *viâ* Ladakh, and some uneasiness was being felt for his safety when he himself suddenly turned up in Assam, having made his way southwards by the eastern confines of Bhutan.

The results of this journey by the foremost pandit were most valuable, considering the fact that almost the whole observations and survey had to be done in secret. They included 1319 miles of careful route traverse, almost entirely over ground previously unexplored, controlled by 276 latitudes observed with the sextant; 497 hypsometrical observations had been taken for height; north of the Brahmaputra the existence of a vast snowy range had been discovered, while the "river of Tibet" itself had been traced a further 50 miles lower down its course than previously.†

But the journey was too much for the pandit. His health broke down almost completely towards the close of the expedition; exposure and hard work had seriously injured his eyesight. Still under fifty years of age, he became anxious to give up exploration and to retire to his native land. Trotter concludes his report of this journey with these words, "Thus having happily survived the dangers and perils of the road, it is hoped that he may spend the declining years of his life in comfort, and with a due appreciation of the liberality of the British Government."

* That Trotter's confidence was not misplaced is evidenced by the fact that Kishen Singh's traverse value for the longitude of Yarkand was 77° 15′ 55″, while the value obtained by Sir F. De Filippi by wireless telegraphy in 1914 was 77° 15′ 46″.

† Report on Trans-Himalayan Explorations during 1873–4–5, drawn up by Captain H. Trotter, R.E., 1876; also *Journal of the Royal Geographical Society*, 1877, vol. 47. The former is reprinted in *Records of the Survey of India*, vol 8, part i

The efforts of his patrons were not disappointed. Nain Singh received a gold watch from the Geographical Society of Paris and the Gold Medal of the Royal Geographical Society. In the proposal for this award, Nain Singh is described as " a man who has added a greater amount of positive knowledge to the map of Asia than any individual of our time." In concurring with the application for the bestowal of a village in Rohilkand with a revenue of Rs.1000, Lord Salisbury, Secretary of State for India, wrote to the Viceroy as follows :

" The successful travels of the Pandit, crowned as they have been recently by a most remarkable journey from Ladakh by way of Lhasa to Assam, have for many years past attracted attention not only in England but among geographers all over Europe. I concur with your Excellency in the high value you set upon these services, and I have much pleasure in expressing my approval of the manner in which you propose to recompense them."

Nain Singh was afterwards made a C.I.E. as an additional reward for his services to geography.

By the date of Nain Singh's retirement the veil had been lifted from Tibet and the surrounding countries. A glimpse had been obtained of the mysterious lands beneath. The quaint lama-ridden people and their customs became known to the world. The recent history, geography, and political conditions of the semi-independent states of Asia were revealed. The carefully compiled reports of both Montgomery and Trotter were of surpassing interest ; and when it is realized that only one of all the old explorers could read or write English, and that they were enlisted on pay at Rs.16 to 20 a month, some idea of the debt we owe to those patrons of exploration may be gauged.

Problems, however, remained still to be solved, and no break in the continuity of the work occurred on the retirement of the master. Further explorations took place in South-East Tibet and its neighbourhood by Hari Ram (M-H),* Lala (L),† Nem Singh (G-M-N), ‡ Sukh Darshan Singh (G-S-S),§ Sarat Chandra Das (D-C-S).‖ On the North-West,

* Two journeys of Hari Ram have already been mentioned. For his third journey in Tibet and Nepal, 1873, see General Report, Survey of India, 1873–74. For his fourth journey, 1885, see Special Report (*per se*), 1887 ; on this journey Hari Ram crossed the great Himalaya 20 miles west of Mount Everest by the Pangu-la ; this pass is that shown on the Everest Expedition map as the Nangbu La. For his fifth journey with his son Ganga Datt (T-G), 1892–93, see Special Report (*per se*), 1895.

† For Lala's explorations in 1875–6–7 see General Report, Survey of India, 1878–79.

‡ For Nem Singh's explorations of the Tsangpo to Gyala Sindong in 1878, see Harman's narrative in the General Report, 1878–79. No account was published of his second journey in 1879–80. For his third journey in Tibet in 1880 see ' Geographical Explorations in Tibet, 1883.'

§ For the explorations of Sukh Darsan Singh see ' Report on Geographical Explorations in Tibet,' by Captain Harman, R.E., 1882. His work was valueless.

‖ See Report on Geographical Explorations in Tibet,' by Captain Harman, R.E., 1882. Lama Ugyen Gyatso (U G) accompanied this traveller.

one other explorer deserves mention, Mukhtar Shah (M-S).* The selection and training of men seems now to have been undertaken by Captain Harman, R.E.

We now come to the last of A-K's journeys; that long persevering adventure that set the seal on his labours and won him applause and honour throughout the geographical world Leaving Darjeeling on 24 April 1878, he travelled to Lhasa and proceeded northwards towards Mongolia.† He met with desperate hardships; was robbed by bandits and deserted by one of his companions who absconded with the transport and everything the robbers had left; in spite of adversity he pushed on and reached Shachow or Tunhwang on the extreme north-west confines of the Chinese province of Kansu (visited in the same year by Prjevalsky's and Count Szechenyi's expeditions ‡), and with his one remaining faithful assistant, Chumbel, he carried out the work allotted to him. In India all trace of him was lost and hope of his return was abandoned. After nearly four years' absence he made his way back by the confines of China and reached India in 1884, to find his only son dead and his home broken up. His own robust health, subjected to so many hardships, had at last broken under the strain; and it was doubted at first whether he would survive.

He too was now forced to abandon further exploration work. While away he had been awarded the First Class Medal of the Geographical Society of Italy, and on his return he was presented with Sanad of Rai Sahadur. On his retirement in 1885 he received from the Government the grant of the village of Itarhi in Sitapur district with a gross rental of Rs.1850, a reward he has had the great good fortune to enjoy for nearly thirty-six years.

In the summary of his statement of services I find the terse remark "Accurate, truthful, brave, and highly efficient." In 1884 there were tests that could be applied to these qualities of the explorer; I am uncertain who has entered this praise; time has proved however that his judgment was correct. More recent work leads one to believe that A-K surpassed even the great Pandit himself in the extraordinary accuracy of his sextant latitudes and of his traverse work.§ His indomitable

* The report of the explorations of M-S, *viâ* Yasin, Kala Panja in Badakshan and on the Western Pamirs, in 1878–81, was never issued to the public.

† Explorations in Great Tibet and Mongolia,' by J. B. N. Henessey, 1884; reprinted in the *Records of the Survey of India*, 1915, vol. 8, part ii.

‡ The plateaux of Tsaidam, though visited by Mongols—besides Tanguts and Tibetans—form no part of Mongolia proper. The original report states that A-K reached "Saichu in Mongolia."

§ Kishen Singh's traverse to westernmost Kansu joined up very accurately with the work of the Russian Prjevalsky. Near Bartang in the province of Kham, over a distance of 120 miles, Colonel Ryder, the present Surveyor-General of India, found that A-K's work agreed within a mile of his own. In this section of the pandit's travels he had hired himself out as a yak driver. A yak is a slow mover, often wanders from the path, and sometimes grazes as he goes. Colonel Ryder's traverse was run with a measuring-wheel. The coincidence of the two results is remarkable.

determination in the face of the greatest hardships and dangers was fully exemplified during his last expedition.

Only once perhaps in the history of the Indian explorers has such perseverance been equalled, and this appreciation may fitly conclude with a brief account of Kinthup's romantic journey down the Brahmaputra.

Doubt had been thrown from time to time on the identity of the Tsangpo of Tibet and the Brahmaputra of Assam. In 1879 Captain Harman observed the volume of water at the junction of the Dihang and the Brahmaputra. A Chinese lama was trained as an explorer and sent into Tibet. His orders were to follow the great river down its course as far as possible, and then to throw specially marked logs into it. For two years Harman had the rivers in Assam watched for the arrival of the logs; unfortunately he was taken ill and forced to leave India, and the watch was abandoned.

Four years passed. Kinthup, who had been in the service of the lama, returned and sought out the survey authorities. He told his story; how the lama had failed in his trust; how he himself had been sold into slavery; how he had worked for freedom and made his way down the Tsangpo to carry out the work allotted to his false master. He detailed the places he passed down the great river and described it in some detail to a point within some 60 miles of the plains of India. Finally he reported how, being unable to proceed further, he had thrown the logs into the river in the hope that the object of the enterprise had been achieved.*

Many years have passed since Kinthup travelled down the Tsangpo. The Survey of India believed his story; geographers in general were inclined to dismiss it as a romance. Before he died the general accuracy of his report was fully proved, minor defects being easily attributed to the fact that the explorer had to rely entirely upon his memory, since he was wholly illiterate and only spoke his native tongue. Kinthup was sought out by the Surveyor-General and called to Simla, where he received suitable reward for the great services he had rendered over thirty years previously.

WRANGEL ISLAND

THE history of the discovery of Wrangel Island is bound up with ideas of a large continent lying off the north-eastern coasts of Siberia. Rumours of islands in this region were current on the mainland from the seventeenth century. During the first half of the next century, a considerable part of this coast and the group of islands, now known as the Bear Islands, were visited by Russian travellers. It was then thought

* 'Explorations in Sikkim, Bhutan and Tibet,' by H. C. B. Tanner, 1889; reprinted in *Records of the Survey of India*, 1915, vol. 8, part ii.