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# THE SCOTTISH GEOGRAPHICAL MAGAZINE.

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## EXPLORATION ON THE TSANGPO OR UPPER BRAHMAPUTRA.<sup>1</sup>

By Captain F. M. BAILEY.

(*With Map and Illustrations.*)

DURING the winter 1912-13 an expedition was despatched by the Government of India to survey the basin of the Dibang river, in one of the upper valleys of which was found the small village of Mipi, inhabited by Tibetans who had settled there a few years previously, after driving out the Mishmis who were the former owners of the land. The expedition made this village the base for their operations in one branch of the river, while the survey was carried up to the watershed. These Tibetans had come from Po-me, and from them we obtained information about that country and the routes leading to it. During a stay of over a month in the neighbourhood, the Tibetans were persuaded to conduct a small party over the passes into Po-me as soon as the road, which is closed in winter by snow, should be passable. This arrangement was not concluded without reference to the lamas and astrologers, who reported favourably on the project.

We considered ourselves extremely fortunate in getting this opportunity of entering a country which had for many years caused much speculation among geographers. Although, as a result of A. K.'s journeys in 1882, it was assumed that the Tsangpo reached India as the Dihang, and so developed into the Brahmaputra, yet this had not been

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<sup>1</sup> Owing to his military duties Captain Bailey finds it impossible to deliver an address to the Society in person during the coming winter, as had been arranged. He has, however, kindly permitted us to print the paper which, in other circumstances, would have formed the basis of his lecture. We are enabled to publish the map by kind permission of the Royal Geographical Society.—Ed. *S.G.M.*

proved by actual observation. Moreover, the difference between the levels of the river in Tibet and in the plains of India was so great as to lead many people to believe in the existence of large falls. Several previous attempts had been made to decide this question. In 1878 a native explorer, G. M. N., was sent from India and followed the Tsangpo down as far as Gyala, but for various reasons his reports were unreliable. Again, in 1884, a better-known explorer, Kintup, was sent. He succeeded in following the river down to Pemaköchung, thence made a *détour*, and, striking the river again below the impassable gorge, followed it down into the Abor country. Owing, however, to the hostility of the people, he was not able to reach India by that route. He reported that there was a fall in the river, 150 feet in height, at Pemaköchung. Quite

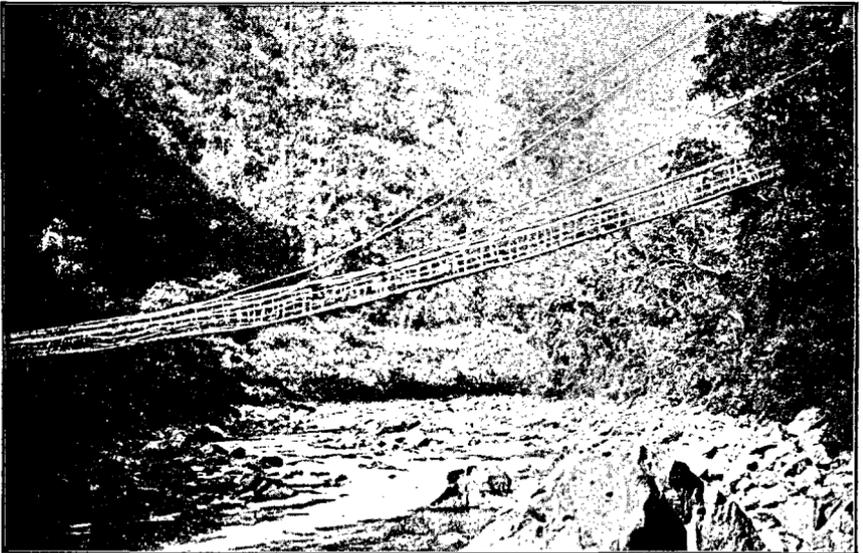


FIG. 1.—Mishmi cane suspension bridge at Aprunyi on the Dibang river.

recently I questioned Kintup on his recollection of these falls, which he then said were only 50 feet in height; from this and from statements in his report, which was published in 1887, it is clear that either he or the interpreter had confused this fall with one on a small stream which joins the Tsangpo at Gyala. Great credit is due to Kintup, who showed extraordinary pluck and perseverance in his explorations, but, as he was quite illiterate, and the account of his travels was given from memory after his return, it is not surprising that several mistakes and omissions occurred in describing the routes he followed. The proposed attempt to trace the river down to the plains on the departure of the mission from Lhasa in 1904 was vetoed by the Government, while more recently the difficulty of moving and feeding troops prevented the exploration parties sent out by the Abor Expedition from going beyond the northern Abor frontier. At the time that our journey commenced,

a party under Mr. Dundas was surveying the Dihang valley, having marched up through the Abor country, and two officers of the Royal Engineers, Captains Trenchard and Pemberton, succeeded in reaching the village of Pe, above the gorge, shortly before our arrival there.

Our object was to cross from the Dibang valley, in which we had been working all the winter, into that of the Dihang, and to follow the river upstream as far as possible in order to map its course, and to ascertain how it descended from the Tibetan plateau, through the Himalayas, to the lower levels at which the Abor expedition had seen it.

On the return of the expedition to India, Captain Morshead, R.E., of the Survey of India, and I collected what stores we could, and started off on our six months' journey. Our party was imperfectly equipped and organised, but this was unavoidable, as we started on the spur of the moment from the most advanced post which had been laid out in the Dibang valley, and had no time to obtain many necessaries from India. We finally left Mipi on May 16, 1913, accompanied by ten coolies and some local guides. Our road led up the Yongyap Chu, and was very rough and little used; this spring we were the first to use it. We travelled very slowly, moving our rations to the Latsa or camp at the foot of the pass. During the whole of this time we had incessant rain, which the guides whom we had brought from Mipi told us would mean much fresh snow on the passes. On this part of our road we supplemented our rations of flour and rice by pheasants, of which there were great numbers, and of which we killed three varieties. The Tibetans had calculated on what day we should reach the pass, and had arranged for the monks at Mipi to hold a special service that day in order that we should have fine weather. We did not reach the pass by the expected day, but noticed that on it more rain than usual fell. We had intended remaining in our camp, which was in 2 feet of snow, at the foot of the pass, until a fine day should enable us to cross over, but, owing to an unexpected and unaccountable shortage in our rations, we were only able to wait one day, on which it rained incessantly, and on the next day we were obliged to start, though the weather showed no sign of improving. Our road lay over snow at first hard and fairly level, but later very steep and soft, and over this soft snow, in which we sank up to our waists, we were obliged to climb 1200 feet in pouring rain and thick clouds. When nearing the summit our guides confessed that they were lost, and we were obliged to wait while men went forward to find the summit of the pass in the dense clouds. This pass, the Yongyap La, proved to be 13,020 feet above sea-level; here we crossed from the basin of the Dibang into that of the Dihang or Tsangpo, in which we remained until we entered that of the Subansiri on September 4. From the pass we had a very steep descent over snow which was continually coming down the hills in small avalanches, and finally came to hard snow over which we travelled until we reached a camping ground below the snow-line. The next morning we woke to find five of our party helplessly snow-blind, and were obliged to wait a day, during which we could only afford to issue half the ordinary

ration. The valley in which we now found ourselves joins the Tsangpo between Bungmo and Meto villages, where it is called the Shümo Chu, and where we subsequently crossed it by a cane suspension bridge. There is, however, no track down the valley to the Tsangpo, consequently we were now cut off from all supplies by two snow-covered passes, one before and one behind us. The next morning the sick were well enough to travel, and we marched one day downstream, after which we turned up a tributary, and, passing the Rirung Tso, a narrow lake a mile and a half in length, ascended a tributary for two days, where we reached a camp in snow at the foot of the Pungpung La. We were now on a pilgrim road which leads from Chimdro to a holy mountain called Kondü Putrang; the track was consequently slightly better. The explorer Kinthup had visited this mountain from Rinchenpung in 1882.

The Pungpung La was crossed at an altitude of 14,300 feet, during a very hard day's march of twelve hours in pouring rain, through soft snow thigh-deep; after crossing the pass we found a small lake at about 13,000 feet altitude, and, passing down a gloomy gorge in which avalanches made a continuous roaring, we eventually camped under an overhanging rock just below the snow-line, some 3000 feet below the summit of the pass.

The whole of our road from one march above Mipi to this point had been through fir forest, in which at certain times of the year takin are plentiful. We saw numbers of pheasants, monal, tragopan, and blood pheasants, which we killed for food. The last were very numerous and confiding. The next day we descended the valley to Chimdro, a collection of villages at an altitude about 6400 feet, in one of which we stopped. This place was ruled by a Dzungpön, who was appointed by the Poba chief. He was somewhat perturbed at our unexpected arrival, but offered to supply us with food and with transport coolies. This was a rather critical point in our journey, as had this, the first Tibetan official we came across, refused to recognise our right to be supplied with food and means of transport, we should have been unable to obtain it anywhere; as it was, on arriving at a village, the people saw that we brought in local transport coolies, and were willing to replace them without questioning our right to this concession. The valley at Chimdro is well cultivated with crops of barley and maize; above the line of cultivation is thick forest.

While here news was received that the Abor survey party were on the Abor-Tibet frontier. After halting two days we left Chimdro on June 3 and descended the valley, reaching the junction of the Chimdro river with the Tsangpo at Kapu in three days, the road being through thick forest and climbing over ladders in many places. At Kapu we got our first sight of the Tsangpo valley. The hills were steep and clothed with thick forest; about 1000 feet above the river there was a belt of more open hillside with cultivation and an occasional village. The river itself was flowing very fast, breaking into rapids in places. At Chimdro the people were Pobas and Khambas, and their houses substantially made of stone and wood with wooden roofs. At Kapu the people

were Mönbas, whose ancestors had immigrated from eastern Bhutan and the neighbourhood of Tawang about one hundred years ago. They had driven out the Abors, who were then in occupation of the land, though some of the Abors had remained and are known to the Tibetans as "Lopas," a name given to all the savage tribes from the Mishmis on the east to the Akas on the west. Several of the villages in this part of the Tsangpo valley are inhabited by these Lopas who, by contact with the Mönbas, have become very like them and wear Tibetan dress. Many of them have adopted the Buddhist religion. The houses of the Mönbas and Lopas in this part of the valley are built of wood or bamboo, usually on piles and with thatched roofs, and are not nearly so well built as those of the Pobas at Chimdro or in Po-me. The people grow crops of maize, marwa, rice, and other sub-Himalayan crops. From Kapu we sent letters to the Abor survey party, and while waiting for an answer moved leisurely down the valley four days to Rinchenpung (6700 feet), a lamasery prettily situated in a grassy hollow in the forest over 4000 feet above the river. We remained here three days, after which we descended into the hot valley of the Tsangpo and retraced our steps to Kapu, hoping every day that the expected answer from the Abor survey party would overtake us. Before reaching Kapu we took a hypsometrical observation for altitude in the river-bed, at a point about half a mile below the confluence of the Chimdro Chu with the Tsangpo, and on a level with the actual confluence of the waters. The height above sea-level proved to be 2610 feet. This was an important point, as we were not able to take another observation at the water-level while in the valley below the impassable gorge. We travelled up the left bank of the Tsangpo valley above Kapu, the road being very bad and hilly, and we had frequent ascents and descents of from 1000 to 3000 feet. The hills as we ascended the valley became steeper and the country dryer, and the thick tropical forests gave way to pines. Round the villages were peach and plantain trees, and in place of rice we found a little barley growing and small quantities of indigo. We estimated that in places the hills sloped up from the river for a height of 5000 feet at an angle of 45°. These hillsides were covered with forest where the precipices did not prevent it. At the village of Pango we found a quarry of soapstone out of which the people make bowls and cooking utensils, which are extensively used in Po-me, and which we occasionally found in Kongbo and even further afield. At the miserable village of Tsangrang we found the Lopa inhabitants pounding the wood of a tree in artificial cup-shaped hollows on a rock. After pounding the fibres are removed, and the residue, resembling sawdust, is cooked and eaten.

On June 19 we reached the village of Lagung, where we found a Poba official, named Nyerpa Namgye, with whom we afterwards made great friends. It would have been possible for us to have continued some 30 miles up the bank of the Tsangpo, and to have reached the junction of the Po Tsangpo at Gompo Ne, but our Poba friend pressed us to go with him direct into Po-me, and, having regard to the general circumstances of the case, we thought it better to take this opportunity of entering an absolutely unknown country at the invitation of one of the local officials, than to risk a misunderstanding with the Poba officials by insisting on dis-

regarding his offer. Another fact which induced us to leave this section of the river was that we believed that we should be able to descend the Po Tsangpo to its junction with the Tsangpo, and then follow the latter river down to Lagung. This eventually proved impossible owing to broken bridges.

We left Lagung in company with the Poba official on June 21, and on the third day crossed the Sü La, a pass which brought us into the valley of the Po Tsangpo, the local name for the lower valley of the Nagong Chu. The pass was 13,445 feet in height, and Captain Morshead was fortunate in being able accurately to fix his position and altitude here by triangulation from the peaks of Namcha Barwa. We ascended over nearly 3000 feet of hard snow, on which the men in places cut steps with their

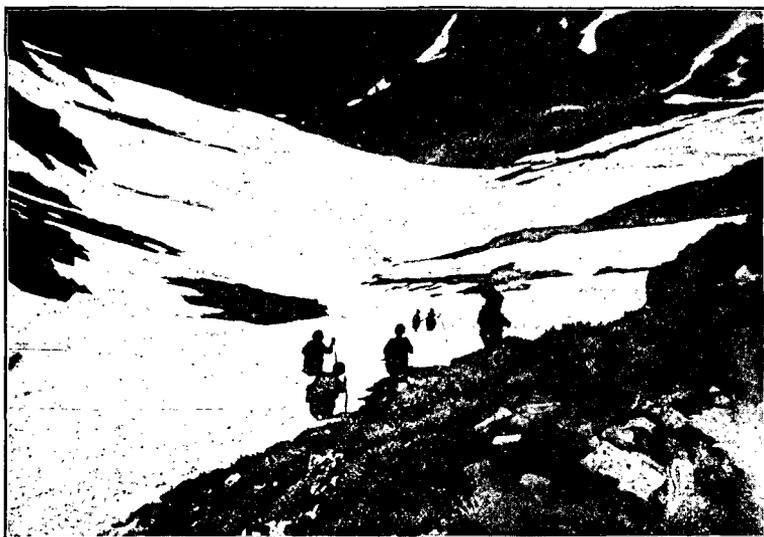


FIG. 2.—Coolies going down from Sü La.

swords, and descended to a camp just below the snow-line. From a point about 1000 feet above the pass we had a good view of a snowy range on the north bank of the Po Tsangpo. On the pass were monal pheasants and another strange game bird; the only specimen which we shot fell 500 feet down the steep snow-slope, and was lost under a snowdrift.

The day after crossing the pass we made a short march, while Nyerpa Namgye went on to Showa, the capital of Po-me, to warn the people of our arrival. He told us that we should probably be kept in Showa as prisoners until a letter had been written to the Abor survey party to ask them if they knew anything about us. Many of the people still suspected that we were Chinese, of whom they were in great fear. The track led down a valley of fir trees, with open marshy clearings, on which were luxuriant grasses and alpine flowers. On reaching the bank of the Po Tsangpo, we were struck by the enormous size and rapidity of

the river. We estimated the width at 80 yards, and the water dashed by in a mass of foam. We travelled down this valley to Showa (8520 feet), the capital of Po-me, which we reached on June 25. The place had been destroyed by the Chinese in 1911. It consists of about forty farmhouses on both sides of the river, which is crossed by a magnificent cantilever bridge of 150 feet span. The fields are divided by thorn hedges, or by rows of peach and other trees; good crops of peas and barley were growing, among which small boys were continually shouting to scare the birds—doves, ravens, crows, and parrots. Higher up the hills were covered with forest. Po-me is to a great extent independent of Lhasa, and was ruled by a chief. This chief was killed by order of the Chinese, and his two wives were taken to Lhasa. They had recently returned, and we wished to visit them, but excuses were made to prevent us. One of them was performing a religious meditation, and could not be disturbed, while the other had toothache. We were visited by the Council, a dirty and unimpressive lot, who had recently been appointed to replace the former members who had been decapitated by the Chinese. They were very suspicious of us, and thought that we had something to do with the Chinese. This suspicion was confirmed in their minds by the Chinese writing on a tablet of Indian ink, which it took us some time to explain. After three days spent in explanations, we satisfied the Council of our harmlessness, and were told that we might go into Kongbo, but were prevented from journeying up the valley, which we were most desirous of doing. While at Showa, the long-expected answer from the Abor survey party arrived, which at any rate convinced them that we were "under the same king" as the Abor party.

On June 28 we left Showa, after the officials had shown us round the ruins of the palace and lamasery which the Chinese had burnt. We descended the valley for three days, when we reached the bank of the Yigrong Tsangpo, a large tributary which joins the right bank of the river. The bridge was broken, and we were obliged to march two days up the Yigrong until we reached a point where some years previously a tributary, the Tralung, had dammed the river and formed a lake (7300 feet in altitude). The breaking of this dam caused the disastrous floods, of which traces were seen in Assam, and which Mr. Bentinek mentioned in his lecture on the "Geographical Results of the Abor Expedition" (*Geographical Journal*, February 1913, p. 107). We were obliged to ford the Tralung, which, though more than knee-deep with a very swift current, is not bridged, as the people say that evil spirits send floods down to take away any bridges that they build. The Tralung had cut about 50 feet, and the Yigrong about 350 feet, through the *débris* which had been the cause of the lake. We were ferried across the lake, in a boat made of two dug-outs tied abreast, to Dre, a village at which we halted for a day. We noticed cormorants fishing in the waters of the lake, and were told that numbers of geese visited it in winter. Iron is mined here, and the people are famous for the swords which they make. From Dre we descended the right bank of the Yigrong to its junction with the Po Tsangpo. Captain Morshead found the width of the water of the combined rivers below the junction, where it was flowing gently,

to be 280 yards. We descended the Po Tsangpo one day to Trulung, a village in which Kintshup stopped when escaping from slavery at Tongkyuk. The village had been destroyed by the Chinese. We had hoped to be able to continue down the river from here to its junction with the Tsangpo, but were prevented by broken bridges, which are carried away every summer. The altitude of the river-bed was here 6420 feet by hypsometer. We were told that from a spur above Trulung we should see the hills above the junction of the river with the Tsangpo at Gompo Ne, but though we waited several hours, the clouds refused to lift. Just beyond Trulung we left the Po Tsangpo, and ascended the valley of the Rong Chu, up which we marched three days to Lunang, the first village which we reached in the province of Kongbo. The road was through pretty scenery, with forest clearings covered with flowers, among which we noticed blue poppies, purple iris, many varieties of primula, and the poisonous aconite, while we were able to eat rather tasteless raspberries all along the road. We now left the Pobas behind, and were among a more civilised type of Tibetan. The Pobas usually wear their hair loose, uncut, and untied. The women do their hair in a peculiar peak over the forehead, which is formed by dressing it over a piece of bamboo, this being concealed by the fringe. The dress is the same as that of other Tibetans, but they are fond of wearing a skin coat with the fur outside on the top of their woollen clothes; the skins used are bear, serow, or gooral. Their language is a dialect of Tibetan, resembling that of the Khambas. The trees were mostly pines, except at the lower elevations in the bottom of the valleys. There were also some fine cypress trees, one of which we measured and found to be 180 feet in height. The people keep bees in most villages in hives made of hollowed-out logs. In the Yigrong valley we obtained a new species of gooral, which Mr. Pocock has named *Nemorhædus baileyi*. Takin and musk deer are found, with bharal on the higher hills, while Tibetan muntjac (*M. lacrymans*) frequent the lower forests. There are several varieties of pheasants, though we did not obtain any specimens; from their descriptions and from feathers which we picked up, these are probably *Crossoptilon harmani*, *Lophophorus sclateri*, and *L. refulgens*—the common and Selater's monal. I shot a specimen of the common hill partridge (*Aboricola torqueola*). At Lunang the people in their language and style of dress are more Tibetan than the Pobas. They wear peculiar hats, like those of clergymen, made of yak's hair felt. Their hair is done in two queues, which are crossed behind and fastened together on the top of the head—a great contrast to the loose, shaggy hair of the Pobas.

From Lunang we marched two days to Timpa, on the bank of the Tsangpo, crossing the Nyima La, 15,240 feet, the pass dividing the Rong Chu from the Tsangpo itself. At the pass the vegetation and character of the country changes with great suddenness, the country in the valley of the Tsangpo being much drier. On the road we were met by some small officials whom the Dzongpön of Tsela, the official in charge of this district, had sent to greet us. The next day, July 13, we crossed the river by a ferry. The river was broad, with a slow current, and just below the ferry it opened out to a width of about 600 yards. The

altitude was 9680 feet. The problem before us now was to follow the river down to the point at which we had left it, and to see how it made the enormous descent to the Chindro confluence, where we had found the altitude to be 2610 feet. The valley is very dry, and here for the first time we found irrigated cultivation, among which were partridges. The crops were the usual Tibetan ones of barley, wheat, buckwheat, and mustard, the country being too dry and elevated for the maize and millet which is grown in Po-me. On the opposite bank we were met by the Dzongpön, who had come down to meet the members of the Abor survey party, who had left eight days before our arrival. The Dzongpön's son is one of the four Tibetan boys at present at Rugby, and is a promising cricketer.

After halting a day we went down the valley 22 miles to Gyala. On

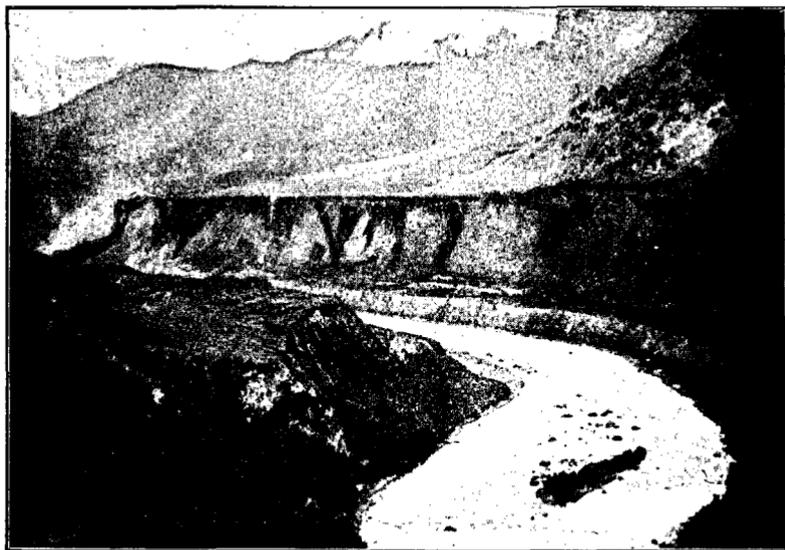


FIG. 3.—View of Tsangpo rapids looking up stream from below Pe.

the road I saw a flock of monkeys, and at Gyala I succeeded in shooting some specimens of the rare Harman's pheasant (*Crossoptilon harmani*). Here we collected supplies for our attempt to follow down the river. We were not, however, very hopeful of being able to descend the valley very far, as at this time of year the track, which is in places in the river-bed, is closed by the water. Four days' march below Gyala we reached Pemaköchung, a small lamasery where Kinthup and the Chinese lama who had been sent to survey had remained three days in fruitless search of a road. The valley became much more wooded below Gyala, and the country is evidently subject to a heavier rainfall. About 2 miles below Pe the river breaks into rapids, and, with the exception of a still stretch near Gyala, these continue down as far as we were able to follow it. About 1 mile before reaching the lamasery of Pemaköchung a road goes

down to the bank of the river at the point where the falls which Kinthup described as being 150 feet in height are situated. The river here rushes through a gorge about 50 yards in width, and at one point dashes down more steeply some 30 feet. This fall was not vertical, partly on account of the rapidity of the current. The people perform a pilgrimage to this place, the pilgrims climbing through a natural tunnel in the cliff. I was able to go part of the way, but the mouth of the tunnel is under water in summer. Just below Pemaköchung a spur called Gyama Taki



FIG. 4.—Kinthup's falls from below. The narrowest part of the Tsangpo gorge, about 50 yards wide.

runs down to the river, and appears to cut off all possibility of farther progress down the valley.

Fortunately a spell of fine weather enabled Captain Morshead to take some observations to the fixed peaks of the Namcha Barwa range, while I occupied my time in investigating the possibility of going further downstream. One and a half miles below the lamasery, after crossing a stream which came from one of the glaciers of the mountain, I reached another named Sanglung. The stream was too large and swift to ford, and too wide to bridge easily, so I moved up stream until I reached the point

where it emerged from the ice-cave of the glacier and was able to cross over the moraine which covered the ice. The snout of the glacier was 9030 feet above sea-level in about  $29^{\circ} 45'$  N. lat. Having found a way to the foot of the spur I returned, and the next day we marched out and camped at a clearing I had found in the forest. Another day was spent in cutting a road 2400 feet up the spur, near the top of which we found a track which had been cut some years previously, but about which our guide, a cattle herdsman of Pemaköchung, knew nothing.

Having cut the road we returned to camp, and the next day crossed the ridge and descended to a stream on the other side, where we camped. From here there was no road or track of any kind, and we spent a day in cutting our way through the jungle, and had some difficulty in finding water, but eventually bivouacked near a small trickle where we were obliged to build platforms on the steep hillside on which to sleep. The next day we continued cutting through rhododendron forest, and eventually found ourselves on a steep cliff which dropped into a stream called the Churung, which also emerged from a glacier. From this point we could see some distance down the valley, and, as we had only two days' food in hand, and as it would have taken us more than that time to reach the next spur and see more of the river, we decided to return. From this point we saw some snow peaks which must have been near the Sü La, and could trace the general direction of the valley of the Tsangpo after it had bent to the south.

On reaching our camp on the east side of the Gyama Taki spur, we were met by one of our coolies who had been sent to Pemaköchung to try and get some more food, and who reported that a party of Mönbas from Pemakö had just come up the bed of the Tsangpo from Payü village, the first time, as we were afterwards told, that such a thing had been done for twenty years. We were now very short of food, and it was impossible for us all to go down the valley, so after rationing Captain Morshead and the coolies to enable them to return to Gyala, where fresh supplies could be obtained, I, with one coolie and the remainder of the food (15 lbs. of flour), went down the bed of the Tsangpo on the tracks of the Mönbas who had returned. I had no difficulty in following them, and soon came on them collecting honey. They offered to help me to go to their village and to send men back with me to Pemaköchung. On their advice I went on a few miles and camped in the bed of the Churung Chu, expecting that the Mönbas would join me in the evening after collecting their honey. However, they did not arrive, and so at day-break I started, and endeavoured to follow their tracks down stream, but could find no trace of their road. While looking for it in the dense forest I had the misfortune to lose my camera, and spent half the day in searching for it without success. In the evening I again camped in the bed of the Churung, and the Mönbas joined me at dusk.

The next morning we started together. The track which we followed was, I was told, made by takin in their annual migrations, and the Mönbas had in places improved it by cutting the jungle or building bridges. At one point some of the people left us and took a short cut to the village of Luku, which is below Payü on the Tsangpo. At length

we left the river and climbed about a thousand feet; the Mönbas then told me that they could not take me to their village, and advised me to return, saying that there was a difficult cliff ahead on which ropes would be required, and that I would not be able to pass it if I wore boots. I insisted on going with them, but as we went they gradually drew ahead

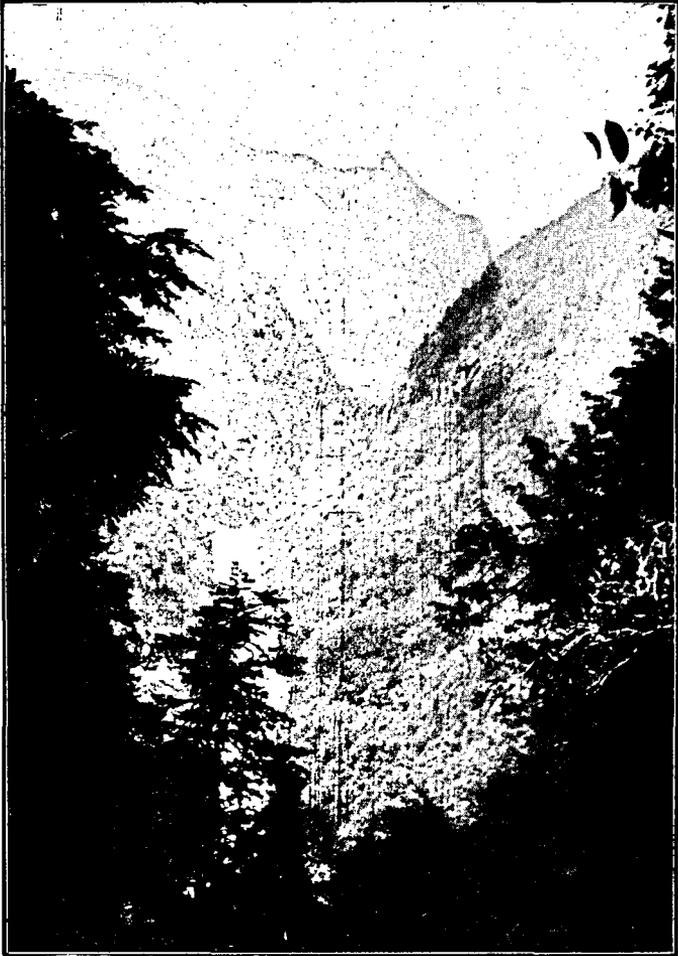


FIG. 5.—View down Tsangpo from ridge beyond Pemaköchung.

and, on rounding a bend of the hillside, I found they had thrown down some of my things which they were carrying and had hurried on. I followed as quickly as I could and saw that the last of them had passed the difficult cliff, and the whole party were hurrying away as quickly as the steep hillside would allow, and refused even to look round when I called. When my solitary coolie arrived we tried to cross the cliff, but found it impossible, as we only had one short piece of rope which was

used for carrying the load. After some trouble I let him down with the aid of this and told him to try and bring the Mönbas back to help us and our load over. He found them cooking a meal a short distance on, but they refused to return, partly I think because, having only one man with me and carrying a good deal myself, they thought I was a person of no importance and not worth taking any trouble about.

Before they left me I had luckily been talking to them about the course of the river here, and got what information they had to give. At the place where they deserted me their road left the Tsangpo and crossed a spur round which the river flows. From this point I returned and attempted to pick up the tracks of the people who had left us for Luku village earlier in the day, but could not find any, and think they must have gone up the stony bed of a stream, probably through the water in places. I then returned as quickly as possible to Pemaköchung, following the Mönbas' road the whole way. It went at the foot of the Gyama Taki spur and avoided the stiff climb over it which we had taken. At Pemaköchung I nearly came to blows with the people before I got enough food to take me to Gyala. At Gyala I found Captain Morshead busy passing the coolies across a rope bridge.

On this part of the river we took frequent boiling-point observations for altitude. These were checked by a trigonometrical altitude on the Sü La, and another at Pemaköchung. The river at Pe is 9680 feet in altitude, and flows quite smoothly, but about two miles lower it breaks into rapids, which continue, in places being extraordinarily steep, for about 16 miles to the neighbourhood of Gyala where the river is again quite smooth. Opposite Gyala a small stream flows through cliffs and drops into this smooth part of the river. This is what Kinthup described as a lake, and it is in this waterfall that the god Shingche Chögye is carved or painted on the rock behind the waterfall. We did not see him, as he is only visible in winter when there is little water in the fall. This still stretch of the river lasts for about 8 miles, after which rapids again commence and continue as far as we were able to follow the river, with the exception of a short, smooth stretch below Gyama Taki, which is followed by a fiercer rapid.

At Nyuksang, a camping ground 34 miles below Pe, we found the river-level to be 8730 feet, giving a drop of 28 feet a mile. The next point at which we took an observation was at the falls at Pemaköchung, where the altitude was 8380, the distance being  $14\frac{1}{2}$  miles and the drop 24 feet a mile. Again, at the confluence of the Sanglung stream, 3 miles further, we found an altitude of 8090, giving a drop of about 97 feet a mile, which includes the 30 foot drop at Kinthup's falls;  $1\frac{1}{2}$  mile further another observation gave an altitude of 8010 feet, giving a drop of 53 feet a mile; 11 miles further at the furthest point I reached in the river-bed, and about two miles below the Churung river, the altitude was 7480, giving a drop of 48 feet a mile. From here we did not see the river until Lagung, the point at which we left it to cross the Sü La. Unfortunately here we were not able to take an observation in the river-bed, but about 45 miles down stream we obtained an altitude of 2610 feet at the confluence of the Chimdro river.

In discussing the question of falls on the river, the above are the data on which we have to form an opinion. Somewhere in this unknown portion of the river the Po Tsangpo joins the Tsangpo. From information received regarding the marches on this river, we have placed the junction approximately on the map, and, by measuring the actual drop of the Po Tsangpo from Showa to Trulung, the point at which we left it, and by supposing that it maintains a similar steepness to its junction with the Tsangpo, we can estimate the height there at about 5700 feet. The Sü La is closed by snow in winter, and the only road from Po-me into the lower Tsangpo valley is that leading down the Po Tsangpo to near its junction with the Tsangpo; the road then goes down the latter river to Lagung, the place at which we left it. We consequently met many people who knew this road intimately, and were able to get a fair idea of the distance from Lagung to the junction, which we put at 30 miles. On this portion of the river the people we asked agreed in saying that there were no falls, though there is apparently an extraordinary turmoil of waters where the two rivers join at Gompo Ne. If we accept the estimated height of 5700 feet at Gompo Ne, and the estimated distance of 30 miles from that place to Lagung, we find a drop of 3090 feet in 75 miles between Gompo Ne and the Chindro river confluence, the next point down stream at which we took an observation. This gives a fall in the river of 41 feet a mile. It must be remembered that we followed the greater part of this 75 miles, and saw that there were no falls on it. There now remains a gap between the lowest point I was able to reach below Pemaköchung (7480 feet) and Gompo Ne (5700 feet). There is no track of any kind on this stretch of the river, and it was difficult to obtain any information, but, from what I was able to find out from the Mönbas who deserted me at the cliff, as recounted above, the distance must be about 20 miles, and the drop 1780 feet, giving a fall of 89 feet a mile. These Mönbas used to hunt takin on the right bank of the river in the neighbourhood of the unknown stretch, and told me that they had occasionally seen portions of the river which descended in rapids; they knew of no great fall, and it is unlikely that they would be ignorant of any enormous waterfall in this neighbourhood.

The distances on the river are estimated by the time we took on the road which follows the river bank. This, of course, only gives an approximate estimate, but it was impossible to measure small distances off the map at the scale at which it was made, and any error in distance should be proportionate over the whole.

The valley below Gyala is thickly wooded and almost tropical in appearance, while higher up the hillsides we cut through forests of rhododendron and firs. The larger animals here are takin, serow, gooral, musk deer, and bears, while of pheasants we saw tragopans and blood pheasants.

The high snow peak called Gyala Peri (23,460 feet, Fig. 6), which Captain Morshead and I had seen from the Mishmi hills some months previously, was an interesting discovery, as well as the glaciers which flow from it and also from Namcha Barwa (25,445 feet). The distance between these two mountains is about 14 miles, and through this gap

the Tsangpo breaks at an altitude of about 9000 feet. This is another instance of the fact noticed by Colonel Sir Sidney Burrard, that the rivers which break through the Himalayan range choose the highest part of the range through which to cut.

At Gyala we crossed the river by a rope bridge, and after inspecting the fall in which Shingche Chögye is tied we proceeded up the valley.



FIG. 6.—View up Tsangpo from below Pemaköchung. Gyala Peri in background.

Above Gyala the country changes with great rapidity, and we were soon in the typical dry Tibetan climate with irrigated crops, though we could see forest up on the hillsides. We travelled up the north bank of the river, and, after visiting the important lamasery of Temo, reached the point at which a large tributary, the Gyamda Chu, joins the Tsangpo. We crossed the former in skin coracles and spent a day at Tsela as the guests of the official who had met us at Pe. From Tsela we had an uneventful journey up the valley, being well received everywhere, and, passing out of

Kongbo province through Takpo, reached Ü, the large province in which Lhasa stands. We crossed the river several times to take advantage of the best road.

In the valley we visited the large and important lamaseries of Trashi Rapden, Ganden Rapden, and Takpo Tratsang; the latter contained an image of Buddha so large that the lower part of the body was in the lower storey while the upper part appeared in the temple on the storey above. We also passed Trung Kang, the birthplace of the present Dalai Lama; here on the site of the cottage in which he was born a temple had been built, into which no one was allowed to enter, but we persuaded them to make an exception in our case. Another place of importance was Lhagyari, the seat of an important semi-independent family, now represented by a boy of thirteen.

In the lower part of the valley, across the range to the south, live various tribes called by the Tibetans Lopas (probably Abors), who cross the range at certain seasons to obtain salt. One valley south of the range, probably the upper part of the Siyom valley, is inhabited by Mönbas, who immigrated about 100 years ago. In the lower part of the Tsangpo valley we noticed many ruins which we were told were the result of an invasion 200 years ago by people called Jungar, whom Colonel Waddell states were Elleuth Tartars. We were obliged to leave the river twice to avoid gorges; once for only one day's march and the second time for five days. The river drops steeply in the part which we did not see on this second occasion, and we estimated a drop of 800 or 900 feet in 40 miles. On both occasions we found that as we left the valley and climbed the hills to the south we came among much larger types of vegetation, larch, birch, and rhododendron, denoting a damper climate. Lower down in its course the river generally flowed in a broad open valley among sand spits and islands; higher up, the valley was narrower and the river more swift with small rapids in places. At most villages there were skin coracles in which the people cross; ponies are taken over in these boats by having their feet tied together and being thrown in on their backs, as their feet would pierce the leather of the boats. The valley gradually got drier as we ascended, and the houses adopted the flat mud roof in place of the pent wooden roof of lower Kongbo. In the drier parts of the valley the only large trees were cypress, except round the villages, where poplars, peach, apple, pear, and walnut trees are grown. The crops included peas, beans, and radishes, vegetables which were a very welcome addition to our fare. Of game we saw bharal, musk deer, and gazelle; the latter were at Lhagyari. We also saw tracks of bears, and were told that monkeys and serow were plentiful in the thicker forest which clothed the hills. There were also numbers of partridges, Harman's pheasants, and snowcock (*Tetraogallus tibetanus*). There was also another pheasant called "Kuling" by the natives, of which we never succeeded in obtaining a specimen. Parrots were common up to a height of about 11,000 feet.

After ascending the valley some 320 miles from the lowest point which we had reached below Pemaköchung, we came to the large and important town of Tsetang, at an altitude of 11,850 feet. The town has a population estimated at about 3000, among whom are some Ladaki

Mohammedans, who gave us a very garbled version of the later developments in the Balkan war, which interested us, as our last newspaper was more than four months old. Here we found the traders very anxious to exchange Tibetan money for our Indian money, and we obliged them to the extent of exchanging eight sovereigns, which traders who visit India understand. In the bazaar, which is similar to those at Lhasa and Gyantse, we saw many articles of European manufacture for sale. We made friends with the head Ladaki trader, who was of great service to us in giving us cash for a cheque when, later on, our money was stolen.

After halting one day we left Tsetang on August 31, and, following the footsteps of the explorer Nain Singh, ascended the fertile Yarlung valley, in which is the town of Netong, of about the same size as Tsetang. In Lharu, a smaller town, we were received by the official, whom I had met several years previously, and were shown a devil dance which happened to be in progress. We also passed a fine temple, called Tramdru, with magnificently ornamented altars, where we were shown a room with 100,000 clay images of Lopön Rimboche, or Padma Sambhava, an Indian saint. As we ascended the valley the cultivation became less, and at the Yar Tö Tra La, 16,700 feet, we left the valley and entered a large uncultivated plain, drained by a stream which joins the Tsangpo below Tsetang. We ascended this stream to its source at the Pu La, where we found people washing gold on its banks. At this pass we left the basin of the Tsangpo for the first time since entering it at the Yongyap La on May 26, and entered the drainage system of the Subansiri. We camped at the village of Kyekye, and the next morning woke to find that three of our ten coolies had stolen all our money and absconded during the night. Although we ourselves searched and sent word to the neighbouring Tibetan officials, we never heard any more of them. Unfortunately, our cartridges were packed with the money, and, except for a few we carried, they were all stolen.

The country in this neighbourhood is elevated, and the villages few and small. The usual Tibetan animals of the uplands were abundant, bharal, gazelle and hares: *Ovis ammon* were also said to be plentiful, but we saw none. From Kyekye we went down to the Char river, a branch of the Subansiri, the valley becoming wooded as we descended; the trees were rhododendron, birch, willow, juniper, and a few firs. Among the smaller bushes were numbers of Harman's pheasants; round the villages walnut and peach trees were growing.

We left the valley of the Char, and, ascending a tributary, crossed into the basin of the Tsangpo by a little used pass 17,000 feet in height. After travelling in valleys, the waters of which eventually flowed into the Tsangpo, we reached the Tsari Chu by the Kongmo La, 17,520 feet. This river is another branch of the Subansiri. The whole of this district of Tsari is considered sacred, and no crops may be grown and no animals killed. We saw a good deal of game, including wolves, musk deer, bharal, and stags (*Cervus affinis*). One of the latter I shot, and this sin was eventually made an excuse for my going round the pilgrimage. The climate of the Tsari valley is very wet, and the hills

covered with thick fir forest. This is peculiar, as the valley of the Tsangpo to the north and the valleys to the south are very dry, and require irrigation for the crops.

We stopped a day in Chikchar, where we saw some holy temples, in one of which the Dalai Lama lived when he performed the pilgrimage in 1900. The idols were beautifully ornamented, and the butter-lamps of solid gold. We descended the Tsari Chu to the last Tibetan village called Migyitün, and then retraced our steps to Chikchar, from which place I separated from Captain Morshead and took the pilgrim road, which was difficult, and crossed several high passes, on one of which was a half-dead glacier. The road leads round a holy mountain called Takpashiri, but atrocious weather prevented us from ever seeing the peak. On the road there were thousands of small white maggots, which eventually become so numerous that the road has to be closed, as to kill one would be to cancel the merit acquired by the pilgrimage. At the Takar La, 16,700 feet, I left the damp Tsari valley and re-entered that of the Char, which we had left about a fortnight earlier. I descended to Sanga Chöling, expending the last shot-gun cartridges on some pheasants and snowcock on the road. Sanga Chöling is a large monastery and the seat of a very holy incarnation known as Drukpa Rimboche, who was away at the time of our visit. I was very well received and entertained here.

I went down the valley to Char Me village, where I rejoined Captain Morshead, who had descended the valley as far as possible and had succeeded in going below the last Tibetan village. We then crossed the range into the valley of the Chayul, another branch of the Subansiri to the south; this we also descended as far as there were Tibetan villages. The road about here was bad, and we had to cross several narrow wooden galleries and ladders. Every twelfth year a large number of Tibetan pilgrims go down the Tsari Chu below Migyitün and ascend the Char river to Sanga Chöling. The accounts given by pilgrims have enabled us to form an idea as to how these rivers flow after leaving Tibet, and indicate that they reach the plains as the Subansiri.

In the villages about here we came across some parties of Daffas, the wildest savages I have ever seen. They had never heard of white people, nor did they know anything about India. Not only would they not accept money for their honey, the only thing of theirs that we wanted, but they appeared to be afraid of it, and to regard it as something noxious. The only articles they wanted were white beads and salt. They dress their hair in a curious way, tying it in a knot over the forehead, through which a brass or bamboo pin about a foot long is passed horizontally, the knot being often surmounted by a tuft of palm-leaves. They had come over the snow range from the south. Near the frontier the valleys became more wooded, and, just below, the country seems to become steeper, and tropical forest commences with great suddenness. In all these valleys which break through the range there is a curious gap of uninhabited country between the Tibetan villages and those of the Lopas, or savages (*i.e.* Abors, Daffas, etc.). The reason for this appears to be that the Tibetan cannot live much below 10,000 feet, while the half-naked Lopa cannot live at anything like that height.

We ascended the Chayul valley, and eventually turned up a branch of it, which is called the Black Loro on account of the dirty water, which looks as though it came from a glacier. On a hill above the junction of the Black Loro and the White Loro, which unite to form the Chayul, Captain Morshead was fortunate enough to get a trigonometrical fixing on some snow-peaks which had been triangulated from India. His station happened to be the hill on which corpses are cut up and given to the birds according to the Tibetan custom, and seeing his party ascending the hill numbers of vultures collected only to be disappointed in their hope of a meal. Up the Black Loro we found rather an obstructive old man in whose house we stopped, and who asked us awkward questions about passports. Fortunately, in the evening we found a herd of bharaal in the hill above his house, and fixed the telescope on it, which so delighted his children that the old man became quite jovial and friendly, and eventually gave us every assistance.

Two days' journey up the Black Loro brought us to the Pen La (17,330 feet), where we left the basin of the Subansiri, and reached a stream which found its way into the Tawang Chu, the waters of which reach the plains of India as the Manas. The stream at which we camped appears to break through the Himalayan range, which we crossed a day later at the Tulang La, 17,250 feet. With the exception of where the Chayul and Char and the rivers of Tsari break through, the range runs in an unbroken line in a south-westerly direction from the high peaks near Namcha Barwa, round which the Tsangpo bends, up to Gori Chen (21,464 feet), a peak east of the Tulang La. From here the range is more broken, but it appeared to us that from the Tulang La the main range went west to Bhutan.

On either bank of the Nyamjang Chu are two parallel ranges running north and south, both of which contain many peaks covered with permanent snow. The range which we crossed at the Tulang La runs into this, but becomes lower, and Nain Singh crossed it at the Mila Katong pass, 14,210 feet in height. We saw nothing of the country west of the Tulang La, and Nain Singh's report furnishes very little information. On descending from the Tulang La, we soon came to damp wooded country again, in the heart of which we found the curious and isolated district of Mago, having a population of about 200. The people are very different in appearance both from Tibetans and from the Mönbas who live in the lower valleys to the south. They grow no crops, as their villages are too high (11,800 feet), in the damp climate, but they subsist on the produce of their yaks, which they exchange for grain. They wear peculiar clothes, and the women cover themselves with jewellery, mostly of amber and cornelian, which is fastened to a silver plate on the head and hangs down beside the ears and over the forehead.

From Mago we crossed a pass to Tse La (15,600 feet), which brought us into a tributary of the Dirang Chu, which itself later joins the Bhoroli. From our camp here we had a view of the plains of India for the first time for eight months. On this part of our road we passed numbers of people from the lower Mönba villages, bringing up grain and madder (*Rubia cordifolia*), a red dye which they exchange for butter and

cheese with the Mago people. We saw blood pheasants (*Ithagenes*) here, but our interest in game birds had not been so great since the loss of our cartridges. After passing the village of Lagam, the people of which are similar to those of Mago, we reached Tembang, the first Mönba village in the valley of the Dirang Chu. We marched up to Dirang Dzong, the residence of an official who concealed himself, and gave out that he was away, in order to avoid the responsibility of stopping us or of allowing us to proceed. On our road we spent a night at Namshu village, where we met a party of Akas, a savage tribe who inhabit the valley of this river below the Mönba villages. From Dirang to Tawang we were on the route followed by Nain Singh in 1875, and were very glad of his survey, as the weather hindered Captain Morshead in his work.

We were now on the main road between Tawang and India, and as far as the people knew we might have just come up from the plains; we consequently had great difficulty in obtaining food and transport about here, and the entire absence of money was another drawback; we now possessed nothing except three sovereigns, which were sewn in our clothes. At length, after great trouble, we managed to reach Tawang after crossing the Se La, which we found shrouded in mist, as did Nain Singh nearly 39 years before. Tawang is an important lamasery which rules Mönbul, the country of the Mönbas. We were here received with some suspicion, but on the whole well. We were taken before the Council, and sat at the base of a pillar in the centre of the council chamber while the councillors, 19 in number, sat all round the walls. The Mönbas are a people very distinct from the Tibetans and resemble more the Bhutanese or Sikkimese. They cut their hair short and wear a felt skullcap; they dye their clothes red, and speak a different language, which is similar to that of Eastern Bhutan. The country they inhabit is lower than that in which Tibetans dwell, and we found them living at heights between 5000 and 10,000 feet, though there were very few villages at the higher elevation. The country is thickly wooded, and the rainfall is considerable. Their crops are those of similar altitudes in better-known parts of the Himalayas. At the time of our journey the chilli crop was being gathered and dried on the roofs of the houses, which made the villages appear to have scarlet roofs. We found the people using a yellow-flowered plant (*Hypericum uralum*) as a substitute for tea, and we were ourselves obliged to fall back on this for a few days. At Lunang in Kongbo we had found them using *H. patulum* for the same purpose. At Tawang we heard that the direct route to Tsöna, an important trading town to the north, was blocked by snow, and as Nain Singh had used the direct road, we were glad of an excuse to take a longer and unknown road.

On leaving Tawang, we marched down the valley, and turned up a large and hitherto unknown tributary, the Nyamjang Chu, which we ascended for three days, when we crossed the high range on its eastern bank by the Pö La (14,000 feet), and reached Tsöna. After crossing the pass, we left all trees behind and again entered the typical dry Tibetan tableland. At Tsöna we found two of our servants who had been sent to take over money from the head Ladaki of Tsetang, to whom we had sent a cheque. The weather was now, on October 23, at 14,500 feet, extremely

cold, and we were thankful to have the means of buying blankets and clothes for ourselves and our servants. Tsöna is an important trading town at certain times of the year, and is the chief centre for the exchange of the produce of the low Mönba country for that of the higher parts of Tibet.

From Tsöna we continued our exploration in order to map the upper waters of the White Loro and the Nye rivers, which form the Chayul and eventually join the Subansiri. We crossed into the Subansiri basin by the Nyela La (16,990 feet); the country near by contained a good deal of game, and Captain Morshead shot two *Ovis ammon*. After completing the survey of the Loro valley to the point at which we had left it to go to Mago, we crossed the range into the valley of the Nye, each of us taking a different road. The passes we crossed were 17,200 and 16,800 feet in altitude. In the Nye valley we reached the Dzong of Lhöntse, the official of which governs the surrounding country. We mapped part of the upper waters of the Nye, and, after following Nain Singh's route up a branch called the Sömpü for a short distance, we crossed the Hor La (17,680 feet) into the source of the Nyamjang river. The cold on the pass on October 30 was intense. The upper valleys of the Loro, Nye, and Nyamjang were very dry, with cultivation below 14,500 feet. The higher valleys are devoted to grazing; we were told that wolves were very troublesome, and we saw the ashes of sheep-dung fires which are burnt in a circle round every camp to protect the flocks.

At the village of Gyao, at the head of the Nyamjang valley, was a small lamasery of five monks, who possessed a fine but absolutely neglected library. I counted roughly 1100 volumes, some of large size. After descending this valley we reached Dongkar Dzong, whence a road which we had hoped to take leads into Bhutan, but owing to snow and other reasons we were not able to manage it. We continued down the valley, and at length came to the point where we had left the valley to go to Tsöna. The river below Dongkar flows through a remarkable gorge. In one of the villages here we had given some medicine to a small girl, who had recovered, and we were now, on our return journey, besieged by the sick, of every village, to whom we gave some harmless medicines, and, we hoped, worked some faith cures. We crossed the Nyamjang Chu, near its junction with the Tawang Chu, by a bamboo rope suspension bridge, which had been made passable for ponies by placing several layers of matting on it and covering these with grass.

We descended the Tawang Chu to Trashigang, an important Dzong in Bhutan, which had been visited by Mr. Claude White some years before. Here we were royally entertained by the official, and were fortunate in coming just as a devil dance was commencing. In this part of Bhutan the crops include cotton, and the lac insect, which is planted out on trees, over which it spreads. From here we took five days to reach the railway. Most of our road was that used by Mr. White. Near the Indian frontier we had some trouble, as the road had been carried away by floods, and we were obliged to ford one stream thirty-two times in a day's march. Our last day's march was mostly over the plains of India, and part of it was done at night in a buffalo-cart. We reached Rangiya station at 2 a.m.

on November 15, after a journey of about 1680 miles from Mipi, which is itself fourteen days' march from the railway opposite Sadiya.

The chief geographical results of our exploration were as follows:—

1. The mapping of some 380 miles of the Tsangpo, which had previously only been done by untrained or unreliable explorers.

2. The mapping of the lower course of the Nagong Chu.

3. The discovery of Gyala Peri, a snow-peak 23,460 feet in height, and of the glaciers on it and on Namcha Barwa, the peak on the opposite side of the river.

4. By taking observations for altitude on the river where it breaks through the Himalayas some information regarding its enormous drop has been gained, and the falls reported to be 150 feet in height have been proved to be merely an exaggerated rapid of 30 feet.

5. The upper waters of several branches of the Subansiri have been discovered, and the fact that this river rises north of the Himalayas and breaks through the range in several places has been established.

6. In the area which Captain Morshead surveyed were many snow-peaks, mountain ranges, and rivers. The two largest of the latter, which were previously unheard of, are the Chimdro and the Nyamjang. Several large towns were visited, and the size and importance of Tsetang and Tsöna had not previously been realised.

In addition to the geographical results, small but interesting collections of mammals, birds, and butterflies were brought back, among each of which were new species.

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## THE DISTRIBUTION OF RAINFALL IN THE NORTH-EASTERN UNITED STATES: ITS CAUSES AND RESULTS.<sup>1</sup>

By B. C. WALLIS.

(*With Maps and Diagrams.*)

THE annual report of the Weather Bureau of the United States provides information about the average monthly rainfall at approximately five hundred stations, which are situated within the triangle of country roughly bounded by the coast, the line of the St. Lawrence and the Great Lakes, and a line stretching across country from the south-east corner of Lake Michigan to the coast of North Carolina. This area includes the peninsula of Michigan, most of the valley of the Ohio, most of the Appalachian highlands, and a large portion of New England. The agricultural activities of the population occur in relation to cereals in Ohio, to tobacco in many of the eastern states, and to cotton in North Carolina. Within this area live the greater proportion of the inhabitants of the United States, and it contains the great manufacturing centres and many of the chief cities.

The rainfall is indicated upon the accompanying maps (Figs. 3 and 4)

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<sup>1</sup> For previous articles, see *S.G.M.*, xxx. pp. 356 and 527.