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Memorandum drawn up by the order of Colonel A. SCOTT WAUGH, *Engineers, Surveyor General of India, F. R. S., F. R. G. S. &c. on the progress of the Kashmir Series of the Great Trigonometrical Survey of India, with map and observations on the late conquest of Gilgit and other incidental matters, by Captain* T. G. MONTGOMERIE, *Engineers, F. R. G. S. &c. in charge of the Series.*

During the field season of 1860, the triangulation of the Kashmir Series has made good progress up the river Indus, and the position of Leh, the capital of Ladak has been finally fixed. Messrs. Johnson and Beverley had to carry their work over some very difficult, rugged, and confined ground that separates the more open valley of the Indus to the south east of Leh* from the table land of Rupshu and Hanle. This was effected in a most skilful and praiseworthy manner though it twice involved the ascent of a station by Mr. Johnson† of 19,979 feet and by Mr. Beverley‡ of another 19,958 feet above the sea, besides numerous other stations all over 17,000 feet above the sea.

A trigonometrical mark has been erected on a point 21,480 feet above the sea, but unfortunately there was not sufficient space to put a theodolite on it.

* Lat. 34° 9′ 30″.05. Long. 77° 36′ 42″·57. Height 11,279 Ft.

† Civil 2d. Asst. G. T. Survey.

‡ Senior Sub-Asst. Do.

Several points in China have been fixed, and amongst others the well known Gya peak is supposed to be included. The height of this peak which I saw last year appears to be from 23 to 24,000 feet above the sea. Further observations have been taken to the group of peaks that I saw at the same time in the Shayok direction: the peaks average considerably over 26,000 feet in height. Some progress has been made with the triangulation of Zanskar. In this work a very rugged and confined piece of ground has been crossed between the valley of the Indus and the more open valley of Zanskar.

On the upper course of the Shayok river (in the Nubra district) the triangulation has been commenced and a good many peaks fixed.

The topographical work was first taken up in the Kishengunga valley, which although drained by a large river is really, for the greater part, little better than a chasm in the mountains. Throughout it is very precipitous, and Ahmed Khan the chieftain of Kurná said to me, in reference to its rocky surface, "A traveller must put on grass shoes if he wishes to visit the Kishengunga valley." It is indeed all but impossible for even the best pedestrians without loads to follow the river from Kurná to Gurais, and any one wishing to do so would prefer going actually along the northern ridge of the Kashmir valley.

The Kishengunga valley, so difficult a piece of country at the best time of the year, had to be taken up when the snow was heavy, even at 9,000 feet. This added very much to the difficulties of the work, but as the Maha Raja's troops were shortly to cross the valley en route to Gilgit, it was necessary to finish early. The work was fortunately completed in very good time, and the whole of the surveyors were then transferred to fresh ground in Little Thibet and Ladak.

During the season topographical sketches were made of the whole of the valley of the Indus, from Skardo the capital of Little Thibet or Baltistan to Leh the capital of Ladak, as well as the whole of the Sooroo and Dras valleys, the plains of Deosai, and a large part of the Shigar valley north of Skardo with a portion of the Nubra or Shayok valley. This large tract of country, in all an area of about 12,000 square miles,—had been triangulated in previous seasons. It embraces all sorts of ground from an altitude of 27,000 feet down in a few

cases to 8000 feet above the sea, though seldom under 10,000 feet. It includes at least 300* square miles of glaciers for the most part of the larger kind. Those glaciers already surveyed to the north of the Shayok have proved to be quite as large as the ones previously measured,† by those very able and energetic topographical surveyors Captain Austen and Lieut. Melville of the Kashmir Series, near the Kún and Nún peaks in the Wurdwan and Sooroo districts. Captain Austen's ground in one part rose to nearly 27,000 feet, and one of the glaciers in the highest ground is about 11 miles in length and from $\frac{1}{2}$ to $1\frac{3}{4}$ miles in breadth. In Lieut. Melville's work, the peaks ran up to nearly 24,000 and under Kún one of the glaciers is about 10 miles long and from $\frac{1}{2}$ to $1\frac{1}{2}$ miles broad. Glaciers are in fact in this section of the Himalayas very much larger and more numerous than in any part of the Himalayas previously surveyed. Possibly this is in some measure due to the latitude, as all these glaciers lie between latitudes 33° and 36° north, but it must also be partly the result of the immense height of the peaks generally as, with the exception of those of Nepal, they exceed all other peaks of the Himalayas that have as yet been measured.

The glaciers in the neighbourhood of the Nanga Parbat and K (2) have not as yet been explored: they will undoubtedly be large, and those of the latter at any rate are, from all that has been seen and heard, likely to prove even larger than the ones already measured. From 3 to 4 marches are occupied in crossing the glacier at the head of the Braldo branch of the Shigar river.

The whole of the country sketched was of a very difficult character, testing both the physical and artistic powers of the surveyors to the utmost in moving about and delineating the country. Circumstances permitting, the whole of the glaciers in the neighbourhood of the Nanga Parbat and of K (2) will be explored during the next field season, as will those of Zanskar and other places. There is hardly any portion of the upper valley of the Indus without glaciers, but they are largest and abound most near the great Hima-

* Lieut. Melville's Sections measured 198 square miles; Capt. Austen's estimated, 150 square miles, in other Sections, 50 square miles. Total, 398 square miles.

† In 1858 and 1859.

layan and Karakorum ridges. The plains of Deosai are perhaps the most curious topographical feature of the country sketched during the season. These plains consist of about 580 square miles of gently undulating ground averaging at least 14,000 feet above the sea and surrounded on all sides by rugged mountains running up to from 16,000 to 17,000 feet. The drainage escaping through a not easily distinguished gorge near the Katasiri station, falls into the Dras river above Kirkitchoo. This tributary of the Dras river is called the Shigar and sometimes the Shingo river, it brings down gold with its waters, and gold-washing is carried on just below the junction. The Indus itself and several other of its tributaries are known to produce gold. The gold-washing is said not to be valuable, but it does sometimes give as much as 1 or 2 small rupees a day to a man, though a most barbarous method is employed in washing the earth. This earth is taken from the detritus which, I think, now generally lies above the highest flood line. After 2 or 3 washings a black heavyish sort of sand is left with the pieces of gold scattered here and there.

As far as my own experience goes I should say it was not a profitable business, for after half an hour's washing I only got 5 very tiny nuggets hardly worth an anna, and I had at the time the benefit of the assistance of an Australian gentleman. This gentleman thought that something might be done by investing in a cradle and apparatus. He said that a substance like the black sand mentioned above, had proved valuable in Australia.

When crossing the Himalaya range the plains of Deosai were a great obstacle to the progress of the triangulation, for although the depression of the Himalayas in that part gave a most extended view from very high points, still there being no habitations for the distance of 7 or 8 marches, and no village of any size for 11 or 12 marches, the operations were carried on under very great difficulties. In the plains the only firewood to be had is got by digging up the juniper roots and from very thin stunted willows, but on the mountains above, there was absolutely no firewood to be had of any kind, the stations being all from 16 to 17,000 feet in height. It was absolutely necessary to reside at least several days on these stations.

Provisions had at all stations to be brought from places 4 to 7 marches distant. The people of the country were moreover not very willing to enter the plains from the Kashmir side. The operations could only be carried on during the rainy season, and at that time there are but few breaks in the clouds which rush through this depression of the Himalayas into the valley of the Indus and across to the Karakoram mountains. With the greatest difficulty the signal men who worked the heliotropes and lamps at the various stations were fed, and on two occasions the main party were starved out and had to retreat in consequence of protracted cloudy weather.

Stations over 16,000 feet above the sea are not the most agreeable places for residence at the best of times, but when enveloped in clouds they are unmistakably unpleasant, though there is some slight compensation in the grandeur of a break up, or when the upper level of the clouds falls, as I have several times seen it fall, below the station on which I was pitched, leaving the camp on an island surrounded with a level sea of clouds from which the peaks of the various ranges stood out like other islands and the waves of cloud surged backwards and forwards across the lower ridges between. In clear weather the views were really magnificent and proportionately appreciated after the cloudy weather. The atmosphere was at such times wonderfully clear at those elevations.

It was across the plains of Deosai from Haramook that I took the first observation to the peak K (2) (28,287 feet above the sea) at a distance of 136 miles, the side of one of our largest triangles.

Notwithstanding all the difficulties the triangulation was successfully carried over the plains of Deosai during one season without relaxing any of the rigorous rules of the Great Trigonometrical Survey of India.

With reference to my last memorandum on the great flood of the river Indus, I have not as yet been able to obtain any further information as to its origin, though the expedition against Gilgit has succeeded as I anticipated it would.

The Maharajah has directed every enquiry to be made, and I hope to be able to give a correct account of the origin of the flood when I return to Maharajah's territories next year. Meantime the expedition has confirmed several important points in the geography

of the countries near Gilgit, and a short account of the expedition itself may be interesting.

The enclosed rough plan is the general result as to the geography of the country annexed, and also shows a portion of the neighbouring countries.

The Maharajah laid in a large supply of food at the forts of Astor and Boonjee during the summer of 1859. Hitherto one of the greatest obstacles to making a successful attack on Gilgit has been the difficulty of getting supplies. The natives are in the habit of using the old expression to the effect, that a small force going against Gilgit was sure to be defeated and a large force to be starved. To obviate this a hundred ponies were put at each of the 17 halting places between Kashmir and Boonjee, viâ Gurais and Astor, and whilst the weather permitted a hundred loads of grain were delivered daily at Boonjee.

In June and July of this year several detachments of sepoys were moved upon Gilgit mustering finally at Boonjee to about 4000 men under Colonel Devi Singh and Colonel Dooloo Singh. The whole body then advanced upon Gilgit crossing the Indus by means of a boat, further on the army crossed a tributary river by a rope-bridge of their own making, and another tributary by a wooden bridge. No opposition was met before reaching Gilgit itself, and there the Gilgities got inside their fort and held out for a short time, during which there was a little firing on both sides ending by the Gilgities surrendering, the Maharajah's force losing one man by the bursting of a gun and the Gilgities leaving one dead man in the fort supposed to have died a natural death during the siege.

Having settled affairs at Gilgit, the force advanced further up the valley to Shirni (Shirwat) fort, where there was some slight resistance ending as before in capitulation. The force then advanced on Yassín which is on the Gilgit river, and not on a separate tributary of the Indus. Yassín fell into the hands of the force and the son of Goramán who held Gilgit in addition to Yassín made his escape over the mountains to the west and on into Bádákshán. Goramán himself died during 1857. He was well known in the whole of the country between the Indus and Cabul and was generally called an Adamkhor, or man-eater, from a habit that he had of catching all

strangers that he could and of exchanging them for the large dogs so much prized in that part of the world. Goramán and his son had till this year held Yassin, and for a short time Gilgit also, though once or twice driven out by the Dogras from the latter.

In addition to the main body of the Dogra force advancing from the south, an armed body of Baltis advanced through Shigar and thence by the Nagar and Hoonza valleys threatening Gilgit on the east.

Another force was to have advanced from the west under the instructions of an agent from Dheer and Chitrál, but it was not apparently in time, though possibly the mere talk of it made the Goramán's son unhappy as to his line of retreat.

This conquest, which may be said to have been made without loss of life, is highly creditable to the Maharajah and his officers who planned and carried it out. The effects are in some respects likely to be very salutary. In the first place, the mere fact of the Maharajah having a force in Gilgit overawes and keeps in check the robber-clans of Nagar and Hoonza who have for years infested the roads between Balti and Ladak on the one side, and Yarkand on the other, and latterly to such an extent that those roads in their immediate neighbourhood, though the shortest, have been almost completely closed to anything in the shape of a merchant. Keeping possession of Gilgit during the cold weather when all communication with Kashmir is closed, has always been the most difficult business. The Maharajah has, however, left nearly 3000 men in the valley and consequently in future it is to be hoped that his troops will hold their own and that the traffic from Skardo direct to Yarkand will again be resumed.

In the second place, this successful expedition has had a very wholesome effect on all the petty tribes lying between Gilgit and the Cabul territories, and ultimately will be of assistance in keeping the Swat valley in check. Swat being still one of the recusant tribes on our N. W. Frontier.

At the durbars of the Maharajah during this season men from Chitraul, Dheer, Swat, Kholi, Palus, &c. were in attendance, as well as from Chilas, Nagar and Hoonza who have been constant attendants for some years.

At the last durbar held by the Maharajah, Colonel Devi Singh made his salam, having just returned from the Gilgit expedition. Some of the Yassín men* were introduced at the same time. One long brass gun of about 3 lbs. bore accompanied the Colonel, his sepoys having taken it from the Goramán's son. This gun seemed to be well cast and had a Persian inscription on it to the effect that it was made in Bádákshán, or had belonged to that place.

Among the minor results of the expedition was a great influx of presents to the Maharajah from all the chiefs between Gilgit and Kafiristan. Perhaps the most valuable in the eyes of the curator of the Asiatic Society's Museum would have been a splendid live male specimen of the Markhor, the greatest prize of Himalayan sportsmen. This animal was introduced into the full durbar guided by four men with guy ropes. It was really a handsome animal, of a light fawn colour, in good condition, with a capital pair of horns and a fine long beard. The top of the Markhor's head was perhaps $5\frac{1}{2}$ feet from the ground, the horns towering up above all the men in attendance. The keepers of this animal evidently held him in the greatest respect, though he had been a captive for at least two months. He was a present from the chiefs of Koli-Palus on the Indus.

The Chilassies sent in some very fine half domesticated goats, a part of which the Maharajah distributed amongst the European visitors to Kashmir. One of these goats now in my possession has a very fine pair of horns of the Markhor kind.

The country on either side of the Indus between the British district of Hazára and the Maharajah's valley of Astor has hitherto been all but impassable. With Chilas, Kholi and Pálús all under the orders of the Maharajah, a very slight pressure ought to open out the remainder down to the Hazára district, which would all tend to bring the Akhoon of Swat to reason, and perhaps eventually enable us to explore his valley and the whole course of the Indus river. At the same time, opening out the whole valley of the Indus is in itself no small advantage, if it will enable travellers to pass along in safety.

* The Yassín men in long dark Khákí coloured woollen dresses. Men of Swat in long dark blue woollen dresses.

Traffic will undoubtedly increase, and moreover the Punjab Government will have the means of getting full information in case the Indus should again be blocked up in any part of its own course or that of its tributary streams. In this latter respect the conquest of Gilgit with Yassín, Hoonza and Nagar is really very valuable, as it places under a friendly native state, the only great tributary of the Indus concerning which the British Government has hitherto been unable to get any reliable information. This tributary moreover is, in my opinion, the one in which the last great flood of the Indus was generated.*

If these countries are in thorough subjection to the Maharajah such a calamity as the cataclysm of 1858 ought not again to befall British subjects on the Indus without their having at any rate full warning; even if it were not possible to prevent or mitigate its evil effects by the scientific application of labour, as it most probably would be.

In my former memorandum I said that I thought floods might be generated in many parts both of the Indus and its tributaries. Captain Austen has just forwarded me the following, which fully confirms that opinion. "Camp Gol on Indus, 29th August, 1860. A flood occurred at Gol about 5 years ago in the month of June. Very muddy water came down the ravine (slowly at first) and the people who saw it, left their houses and ran up the hill sides. Twelve old men, who could not run away, were drowned, twenty houses and about five hundred apricot trees were washed away. There was but little snow on the hills at that time, and the ravine is by no means a large one. The villagers go up it constantly and yet were not aware of its being in any way dammed up, though the water must have been in considerable quantity, as the flood altered the course of the Indus. It is a mystery to me where sufficient water could have been collected. This account was given by Wazzír Husain of Gol."

(Sd.) H. H. G. A.

The Balti force that went from Shigar viâ Nagar to Gilgit had to cross a very large glacier. The route obtained by Captain Austen, attached to this, shews that it takes a man the whole day to cross it.

With reference to the Society's discussion about Kyangs. A great

* See memorandum published in As. Society's Journal, No. I. of 1860.

many Kyangs have been seen by myself and others. I have watched a herd for a long time at a short distance with a telescope. I have not heard them calling, but Mr. Johnson, who caught a foal* this year, says that they bray, he heard them several times quite distinctly, and the natives† with my camp say the same. I saw a very large skin of a Kyang shot by Mr. Johnson this season in Rupshu. There was a black mark all the way down the back, but not the least sign of any stripe on the shoulders, the skin of the tail was about 13 inches long, and the whole tail not more than 2¼ feet in length. But this I think exceptional, as some of those in the herd I examined had tails reaching nearly to the ground. The ears and tail struck me as being like those of a mule, and I thought them generally very high in the withers and much larger than any of the wild asses of the salt range.

The season of 1860 has not been a favorable one as far as the weather was concerned, it was indeed peculiarly unfavorable for the triangulation in the upper part of the valleys of the Indus. The late very heavy falls of snow in March were never thoroughly melted away. Before the triangulating party left, the whole of the smaller streams remained hard frozen during the day. The Kyangs and even the geese, ducks and other waterfowl all left the neighbourhood of the Chomoriri lake as early as the end of August. It was so cold that even at the end of July, I crossed over some snow bridges in Ladak that in ordinary seasons disappear before the end of June. The Máchához glacier projected further than usual into the Dras valley, and its end did not melt back very much till the close of the season. Bad weather set in early in September and soon after all survey work was forcibly brought to an end.

It is to be hoped that we may have no more such seasons. With favorable weather I think we may succeed in carrying both the triangulation and topographical work up to the Chinese frontier. The triangulation may possibly advance a little further even as matters now stand. And if the present war with China results in friendly relations extending to all the provinces of that empire, we may hope to see a large traffic spring up between Hindustan and central Asia.

* This foal died after a fortnight's captivity.

† Kainchna or hainchna was the termed used by them.

The triangulation of the Great Trigonometrical Survey may be joined on to that of Russia, and thus accomplish the project of Colonel Everest the late Surveyor General of India, who wished to measure the arc between Cape Comorin and Nova Zembla, an arc that would include nearly 70 degrees of the earth. To accomplish this there at present remains a gap of little over 5 degrees of Chinese territory, the operations of the Kashmir series extending beyond Lat. 36° and the government of Tobolsk now coming down below Lat 42°. At any rate if the war makes the Chinese officials on our North East frontier friendly, we may succeed hereafter in fixing the geographical positions of some of the great cities of central Asia.

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In charge Kashmir Series.

Route from Skardo viâ Shigar and Nagar to Gilgit.

No. of Marches.	Distance in Miles.	Names of halting-places.	REMARKS.
		Skardo to, ...	
1	18	Shigar, ...	A large village.
2	15	Kushamul, ...	A village.
3	16	Chutran, ...	Literally hot water from a hot spring.
4	20 each of these marches occupies nearly the whole day.	Arundu, ..	Village.
5		Yak Kole, ...	Very bad road crosses a pass and goes over a very long glacier.
6		Hai-Hutun, ..	A bad road.
7		Hispir, ...	A village, march longer than usual.
8		Hoper, ..	A village.
9	3	Nagar, ..	Do.
10		Pakher, ...	Do. a long march.
11		Nillit, ...	Do. Do.
12		Chaparote, ..	Do. Do. in Gilgit.
13		Naomul, ...	Do. Do. Do.
14		Gilgit, .	Do. Do. Do.

N. B.—The Hoonza river is very much smaller than the Shigar. There are three roads from Hoonza to Yarkand, one that takes 12.

another 8, and another no more than 4 days. The last being only known to the natives of the country and not to the merchants who go to Yarkand. The man who gave the above said he had gone by the Nagar and Gilgit routes.

(Sd.) H. H. G. A.

Route from Kashmir to Gilgit viâ Gurais and Astor.

No. of Marches.	Dstance in Miles.	Names of halting-places.	Remarks.
		Srinagar to, ...	
1		Sinbul, ...	
2		Bundipoor, ..	
3		Trakbul, ...	
4		Jotkusu, ...	Cross the Kashmir ridge.
5		Kanzlawan, ...	
6		Gurais, ..	
12		Astor, ...	Cross the Himalayan watershed during 3rd march.
16		Boonjee, ...	
22		Gilgit, ...	Cross the Indus by boat close to Boonjee.
		Total ... 22	marches.

The routes given from Hoonza to Yarkand (though the 4 days may be apocryphal) all tend to shew that Yarkand must be nearer the longitude of Skardo than of Leh, the latter route being reckoned at least 16 days from the Karakoram ridge; and the 4 days may be given on the strength of the wonderful rapidity with which the Hoonza-Nagar people got warning of the Kafilas leaving Yarkand, so quickly indeed was this given that the Hunza-Nagris were able to make all their arrangements in Hunza and then to cross into the Shigar valley and still be in time to rob the Kafilas before they reached the inhabited parts of Ladak and Balti.

T. G. Montgomerie, Cap. Engrs.