EXPLORATIONS

IN THE

EASTERN KARA-KORAM AND THE

UPPER YĀRKAND VALLEY.

NARRATIVE REPORT OF THE SURVEY OF INDIA DETACHMENT WITH THE De FILIPPI SCIENTIFIC EXPEDITION 1914.

PUBLISHED BY ORDER OF THE GOVERNMENT OF INDIA.

Dehra Dun

PRINTED AT THE OFFICE OF THE TRIGONOMETRICAL SURVEY

1922

Price Three Rupees or Six Shillings.

Kirghiz family in Kulshish-Kun valley.

Frontispiece.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

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PREFACE.

This report was originally written in Rome during January 1915 after the expedition had completed its work, for submission to the Superintendent Trigonometrical Surveys, under whose direction the detachment of the Survey of India had been placed.

Owing to the European war, the official account of the work of the whole expedition could not be prepared, and as it was not desired to anticipate that account, the publication of this report was delayed. This delay has enabled additional information, which was not available in 1915, to be incorporated in this account, which, though based on the original document, has been rewritten.

The illustrations are from my own photographs, and have been selected so as to give views of that part of the country which was only visited by the survey party. Unfortunately most of my photographs had been left in England, and as the negatives could not be procured, the reproductions have mostly been made from prints which had been used a good deal. The reproduction offices of the Survey of India have done their best with very indifferent material, and the defects are in no way due to their work.

In conclusion I desire to thank all those officers, who have assisted in the publication of this report, and in particular Major K. Mason M. C., R. E., who not only has very kindly written an introduction, but also gave me much valuable help in correcting the manuscript and in proof reading.

MUSSOORIE.
May, 1922.

H. WOOD

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INTRODUCTION.

The report published in the present volume deals with the work of the Survey of India detachment attached to Sir F. De Filippi's expedition which set out from India in the autumn of 1913, to undertake geophysical researches and geographical exploration in the little known and rarely traversed regions of the Kara-koram at the headwaters of the Shyok and Yārkand rivers.

The expedition had the support of H.M. the King of Italy, of the Royal Society, the Royal Geographical Society, and of the more important scientific institutions of England and Italy. The Government of India liberally contributed towards the expenses of the enterprise, and the Surveyor General deputed a detachment under Major H. Wood, R.E. to accompany the party in order to assist in the survey of the areas traversed.

This detachment was primarily concerned with the geographical exploration of the Kara-koram, with its immense glaciers and ice-covered mountains, and of the little known sources and tributary rivers of the upper Yārkand river. The preliminary survey of these areas had been initiated under Sir Andrew Waugh and General Walker during the Kashmīr survey, by Captain Godwin-Austen and Mr. E. C. Ryall in 1861 and by Mr. W. H. Johnson in 1864 and 1865. It was known that the reconnaissance maps of these early pioneers, executed before mountaineering became a studied art, were but rough estimations of the true topography of the region, and the subsequent travels of Shaw and Hayward in the later sixties of last century, and more particularly those of Sir Francis Younghusband in 1887 and 1889, of the Duke of the Abruzzi and of Dr. T. G. Longstaff in 1909, had raised many interesting geographical questions. These dealt with the glacier sources of the Oprang and Shyok; the headwaters of the Yārkand river; the north-eastern and northern watersheds of the great Siachen glacier, and, the whole area on both sides of the main caravan route by the Kara-koram pass.

Major Wood's report details the extent to which these problems have been solved. He narrates the discovery of the glacier origin of the Yārkand river, thereby correcting the topography as recorded by Hayward; he describes the intricate country bordering the watershed west of the Kara-koram pass and in the upper tributary valleys of the Yārkand river. Finally he shows how he ascended what he believes to be the line of an old route leading across the head basin of the Oprang.

The survey of the latter valley is indeed the only portion of the programme of the expedition which was not fully carried out, and its exploration forms the last geographical problem unsolved in these parts. We know that Younghusband crossed the Aghil pass in 1887 into the Oprang valley and by the difficult Muz-tāgh pass reached the Baltoro glacier; that two years later he again crossed the Aghil pass and ascending the Oprang valley, passed the snout of the large glacier descending from the eastern faces of Gasherbrum; and that he then ascended another large glacier, the Urdok, leading in his belief to a col over the main watershed. No other European has yet penetrated the locality. Members of the Duke of the Abruzzi's expedition in 1909 must have seen part of the Gasherbrum glacier from 'Windy Gap'; Longstaff has corrected the faulty topography of the Siachen glacier, and shown that the watershed lies much further north than was supposed; and in 1912 the Workmans followed Longstaff's footsteps to the Siachen and reached a col at its head overlooking, in their belief, the Urdok glacier.

The De Filippi expedition has now completed the survey of the Remo glacier, and connected it with that of the Siachen

by Peterkin of the Workman expedition; and, as is described in this report, Major Wood has viewed from passes on the watershed west of the Yārkand river what he believes to be the upper valley of the Oprang. If the surmises of Major Wood are correct, the Urdok and Younghusband's glacier sources of the Oprang must all lie in tributary valleys.

The text of this report deals mainly with the explorations and survey carried out by Major Wood's detachment. In an appendix he has collected much interesting evidence regarding the lost passes of the Karakoram, a subject closely allied to the exploration of the district.

In addition to the geographical work of the expedition, the programme included the establishment of a chain of geophysical stations for observations of gravity and magnetism, linking up the methodical work of India with that of Russian Turkistān; meteorological and aerological researches; measurements of solar radiation; and observations regarding botany, geology and anthropology. The publication by Sir F. De Filippi of these investigations has been unfortunately delayed by the Great War and, as yet, the results are not available. A reference however, with some preliminary details, to the wireless longitude work will be found in *Records of the Survey of India*, Volume VII, page 153.

Dehra Dūn.
2nd February 1922.

KENNETH MASON,
CAPT., R.E., AND BREVET-MAJOR,
Offg. Deputy Superintendent, Survey of India.

The work of the Survey of India Detachment with the De Filippi Scientific Expedition to Central Asia 1914.

I. THE MARCH TO THE DEPSANG PLATEAU.

Composition of detachment

The members of the Survey of India attached to the De Filippi expedition were Major H. Wood, R.E., Deputy Superintendent; Mr. Jamna Prasad, Sub-Assistant Superintendent and Surveyor Shib Lal.

This detachment assembled at Dehra Dūn during March 1914, and the necessary data, instruments, equipment etc., having been collected, it left that place on March 28th, 1914. Srīnagar (Kashmīr) was reached on the 31st idem, where, on April 9th, the second party of the expedition—Messrs. O. Marinelli (geologist), C. Alessandri (meteorologist) and A. J. Spranger (topographer) arrived from Europe.

At Srīnagar

At Srīnagar, supplies for the march to Leh were procured, and transport arrangements made for the journey. Bad weather delayed the start till the 13th April, as the local authorities would not permit a large caravan to cross the Zoji-la, which was not yet officially open, unless the weather conditions were good. The European party had brought with them much scientific equipment, so that, with the survey kit and supplies, 120 coolies were required. Lance-Naik Lal Bahadur and Rifleman Narjun Gurung of the 1st Battalion 5th Gurkha Rifles, whose services had been very kindly placed at my disposal by their Commanding Officer, also joined at Srīnagar.

Arrival at Leh

Bad weather pursued us up the Sind valley, and at Gund we had to halt a day, as the reports from the Zoji-la were unfavourable, but this pass was crossed in the early hours of the 19th April, fortunately in fine weather. The remainder of the march was completed without incident, no difficulties whatever being experienced, thanks to the excellent arrangements made by Captain Gabriel, I. A., British Joint Commissioner for Ladākh. We reached Leh on the 29th April, and there met the first portion of the expedition—Dr. F. De Filippi (in command), Commander A. Alessio, R. I. Navy (second in command) and Professor A. Abetti (physicists), Professor Dainelli (geologist), Marchese Ginori (meteorologist), Lieut. A. Antilli, R. I. Engineers (photographer) and G. Petigax (Alpine guide), who, arriving from Europe in the preceding autumn, and after wintering at Skārdu in the Indus valley, had reached Leh some time before us.

Commander Alessio was also in charge of the topographical work, but he very courteously allowed me independence in the work allotted to the Survey of India detachment. The general plans for the survey of the country we were to traverse were :—

Proposed programme

(1). During the march to the Depsang plateau and the halt there, Spranger and I were to undertake what triangulation was possible, while Jamna Prasad and Shib Lal were to execute the topography under my supervision.

(2). On leaving the Depsang, Alessio and Abetti would carry out such triangulation or traversing as might be found feasible during the exploration of the Remo glacier, with Jamna Prasad employed on the detail survey. Spranger and I, with Shib Lal, would be responsible for the general survey, confining our attentions more particularly to the watershed between the Remo and the Kara-koram pass, and to the headwaters of the Yārkand river.

The allotment of the work subsequent to the completion of this part of the programme was, later on, the subject of so many changes, that the original scheme need not be mentioned. In accordance with the plan mentioned

in (1) above, as the expedition was to follow the new, and hitherto unsurveyed, routes to the Depsang, over the Chang-la and along the upper Shyok river, I decided to start the survey from the vicinity of Leh. Jamna Prasad commenced work on the scale 2 miles to 1 inch, devoting himself principally to the survey of the road; while Shib Lal, using a scale of 4 miles to 1 inch, was to make a survey of as much of the surrounding country as possible.

Basis of triangulation

To provide points for the survey I started a triangulation, basing it on the coordinates of two stations which I visited—Nangasago h.s. (of the Shyok series, observed from by Mr. Neuville in 1860: λ 34° 13′ 49″·63, L. 77° 39′ 57″·00, H. 18,949 feet) and Sabu h.s. (a subsidiary station of Mr. Beverley's upper Indus series of 1859; λ 34° 7′ 44″·48, L. 77° 40′ 7″·33, H. 14,749 feet). From these, several other stations in the neighbourhood were fixed and peaks of the surrounding hills intersected.

Observations at Leh

One of the new stations was on the site of the Leh astronomical station of Alessio and Abetti. The difference between the triangulation and astronomical co-ordinates of this station are for latitude 14″·5 and for longitude 10″·5. The astronomical longitude was determined differentially from Dehra Dūn by means of wireless signals transmitted from Lahore. These differences indicate northerly and easterly deflections of the plumb-line.

Passage of the Chang-la

The whole expedition left Leh on the 15th May. The route was, as mentioned above, by the new road over the Chang-la, and thence along the upper Shyok river. It was intended to keep up triangulation and plane-tabling during the march, but on the night of the 17th May, when we camped at the foot of the Chang-la, heavy snow fell. This continued the following day until after the pass had been crossed; and as the march could not be delayed, the storm made an effective break in the triangulation, although the surveyors managed to carry on the detail survey.

Observations near Shyok

The hamlet of Shyok—the last inhabited spot we were to see for nearly 5 months, was reached on the 19th idem; here we halted two days to re-organise the transport arrangements. I utilised this halt to make three triangulation stations in the vicinity, by resection from some of the points, whose positions I had previously fixed. These stations were valuable, as they afforded a check on the plane-tabling after the break caused by the snow-storm on the Chang-la; and also furnished a base from which I was able to intersect several peaks in the direction of our march up the Shyok river.

Upper Shyok valley

After leaving Shyok, the new road keeps to the lower slopes on the left bank of the river, but, except during the time of floods, traffic follows the old track in the river bed. For several days' march the stream is confined to a deep and narrow gorge with rocky and precipitous walls, out of which it was impossible to climb sufficiently high to do any effective triangulation as well as make a march the same day, so again this work had to be temporarily suspended, while the surveyors could do little more than keep up a traverse of the route. As a check on their work, I took star observations every alternate night for time and latitude.

Control of plane-tabling

On the 25th May the valley opened out, and on this day and again on the 27th, I was able to make triangulation stations. But owing to the distance from previously fixed points, I was unable to do more than fix the position of the stations. These, however, with the astronomical observations, control the plane-tabling adequately, as this section of the survey is of small extent.

Arrival at Kataklik.

On the 28th, the camping ground of Kataklik was reached. Here the new road leaves the main valley and follows the bed of a tributary leading to the camping ground of Murgo, where it joins the old summer route from Leh, *via* the Sassir pass. This tributary, a few miles from its junction with the Shyok river, flows through a very narrow gorge. The road lies in the stream bed, and during the hours when the floods caused by the melting of the snows come down, is decidedly dangerous. These conditions occasioned a temporary break in the detail survey, as on the 30th May, Abetti, Spranger, Jamna Prasad, Shib Lal and I, after making a station, reached the gorge late in the afternoon, by which time the stream was a raging torrent;

though when the main party, with the transport, had passed earlier very little water was coming down. Abetti, Spranger and I, who were riding, managed to get through after several narrow escapes; but the two surveyors and the coolies carrying the instruments, who had been unable to keep up with us, reaching the gorge later, found the current too strong. They were forced to spend the night in the gorge, and only reached camp next morning, when the flood had subsided. We were now but two days' march from the Depsang, where it was proposed to remain some time; so in preference to leaving the surveyors behind, I decided to close the plane-tabling temporarily, and later on to send one of them back to complete the survey of the road.

II. THE SURVEY OF THE DEPSANG PLATEAU.

Arrival at Depsang plateau

We reached the Depsang plains on the 2nd June, and established a standing camp near the north-west corner of the plateau, most of which was still under snow. On that night I took observations for time, latitude and azimuth, but for the next eight days continual snowstorms prevented much triangulation by day and any further star work at night. During this period, the greater part of the surrounding country was permanently enveloped in cloud, but in the occasional clear intervals I took observations to two snow peaks, which I thought I had identified correctly. Unfortunately, they were situated nearly east and west of our camp, and so were of no great value in determining its position.

Base measurements

To make sure of the identification of these two peaks, I measured a small base, with the intention of fixing them from its extremities, and so comparing their distance apart thus obtained, with that computed from the known coordinates of the peaks I supposed them to be. Before this could be completed however, we began to receive the wireless time-signals from Lahore, so, knowing that an accurate value of the longitude of the astronomical station would eventually be available, I decided to start triangulation from a well-measured base, with astronomical values for latitude and azimuth—these Commander Alessio very kindly offered to make—and with an assumed value for longitude. This latter could be corrected when the true value obtained from the wireless time-signals had been computed.

Measurement of base

A practically level base, about 6000 feet in length, was selected north of the camp. Large flat stones were aligned by a theodolite centred over one end of the base, and embedded 330 feet apart, and on their upper surfaces, which were flush with the ground, direction lines were drawn. Two measurements of this base were made—one in each direction—with a 330-foot watch spring tape, which was compared, both before and after use, with a standard of 96 metres, which Alessio and Abetti laid down for me, using their Jäderin apparatus. The two values of the base differed by 0·19 inches, and its length, after correction for error in the length of the tape obtained from the comparisons with the standard, was 5946·49 feet.

Triangulation of Depsang plateau

Emanating from this base a triangulation net was laid out to extend over the low hills on the plateau: six stations were selected, which included the astronomical one where the observations for latitude and azimuth had been made. By the 11th June, the work at this and three of the other stations had been completed, but this was then temporarily suspended, to enable me to accompany Dr. De Filippi on an excursion to the foot of the Remo glacier to make plans for its subsequent exploration. We started on this expedition the following day. The weather now changed completely, and during the march I was able to make a station and take observations to many snow peaks. On each of the succeeding days until the 16th, when we returned to our standing camp, stations were made and valuable observations obtained.

View from Remo glacier snout

The Remo glacier, viewed near its snout, is a most imposing sight. Two branches are visible, which unite to form a front fully two miles broad. The western branch is very wide and at its head is a conspicuous group of peaks; the highest of these was fixed by Mr. Collins in 1911, and was called by him No. 7, but is now designated Pk. 50/52E, height 24,190 feet. This mountain is, I fancy, the one seen by Dr. Longstaff

from the Rgyong-la, and which he thought was Teram-kangri. When I saw it, later on, from a point more or less in line with it and the Rgyong-la, the peak had a very similar appearance to that shown on Dr. Longstaff's photograph taken from the pass. The northern branch of the Remo is narrower and much longer than the western one and could be seen seen extending towards the group of peaks named, on the Bullock Workman's map of the Siachen glacier, "the Apsarasas".

Origin of name "Remo"

I could obtain no local name for the glacier, though its existence is undoubtedly known to the traders who go to Yārkand. They apparently have no name for it, as it is on one side of the route. This is in accordance with my experience generally in India, the inhabitants of which country only give names to natural features that are useful to them or form obstacles, such as camping and grazing grounds, streams, passes, etc. Mountains and places to which they do not go have no interest to them whatever and are consequently not named.

W.H. Johnson's visit to Remo

The name Remo appears to have been first used on Atlas sheet No. 44A, which, in this neighbourhood, is based on the surveys of Mr. Johnson in 1864. When he visited this area the summer trade route was as it is now, that is, up the Murgo stream and across the Depsang plateau. This route was followed when periodic advances of the Kumdān and Āk-tāsh glaciers blocked the Shyok valley, which the old normal route followed as far as its junction with the Chip-chak stream, along which it then continued to Daulat-beg-öldi where the alternative road joined. The Chip-chak joins the Shyok a mile or so below the snout of the Remo, so from the usual route the glacier was a prominent but not obstructive object. It is therefore quite possible that in Johnson's time, a little-used name for the glacier was in existence but has now been forgotten.

Observations of R. Shaw

Mr. R. Shaw, the first Englishman to visit Kāshgar, followed the normal track in 1869 on his return journey to India and apparently heard no name for the glacier. He gives not only a very vivid description of the glacier but also a sketch of it by him forms one of the few coloured illustrations of his book. [1] He appears to have been the only traveller till recent years to describe the glacier or to realize its size; and the absence of any name in his report is remarkable, as he gives the well-known name of 'Khoomdan' to the next glacier but a few miles further down the Shyok.

I could obtain no meaning for the word Remo in any of the local languages, but I was told that in Turki it means lines, bands or streaks. This might conceivably apply to the glacier's medial moraines which are prominent.

Completion of Depsang triangulation

On our return journey I made a triangulation station on the highest hill on the Depsang. The atmosphere was very clear, and I was able to observe to peaks in every direction, including several which had been fixed by previous observers (Teram-kangri and K 2 amongst others). Next day, from another hill, I again took observations to many of the same peaks. I had thus made ten stations on the hills of the plateau, and from them had taken observations to 60 or 70 new peaks in the neighbourhood; and I was also certain of the correct identification of several of the peaks fixed by previous observers. I accordingly decided to compute the positions of two of my stations by resection from the observations to the known fixed peaks, and base my triangulation on the distance between my stations thus obtained. This entailed the abandonment of the idea of commencing the triangulation from a measured base; but as my more recently observed stations were connected to those around the base, I was able to compare its measured length, with that derived from the triangulation. This difference was 3·07 feet. The astronomical value for the latitude of the astronomical station and its longitude derived from the wireless signals from Lahore were computed in 1921 by Alessio and Abetti. The triangulated values differ from these by 2·8″ in latitude and 6·0″ in longitude, indicating a small northerly and easterly deflection of the plumb-line.

Triangulation computation

The computation of the triangulation observations occupied Spranger and myself till the end of June. In the meantime

[1] High Tartary, Kāshgar and Yārkand. R. Shaw. London 1871 P. 432.

Jamna Prasad had started a survey of the Depsang plains, while Shib Lal went back to Murgo to complete the survey of the road, and also to carry out, so far as he was able, a survey of the old route up the Shyok river. He found the Kumdān glaciers blocking the river, and was unable to cross them.

On the 1st July Dr. De Filippi, accompanied by Alessio, Abetti, Antilli, Petigax and Jamna Prasad, left for the Remo. I had fixed a certain number of peaks for Jamna Prasad's use but Alessio hoped to supplement them. A full report of the exploration of the Remo glacier has been given in Sir F. De Filippi's paper read before the Royal Geographical Society, and as this has been published in the journal of that Society (Volume XLVI, 1915, pp. 85 *et seq.*), it need not be repeated here.

De Filippi leaves for exploration of Remo

III. EXPLORATION OF THE UPPER YĀRKAND RIVER.

Programme of Survey detachment

On the day following the departure of the Remo party Spranger and I, with Shib Lal, left the Depsang camp. Our work was to investigate the correctness, or otherwise, of the mapping of the stream—subsequently referred to as stream A—which rises near the Kara-koram pass and flows north and west of it. This stream is shown on the Atlas sheet (44 A) as draining into the Remo glacier, and therefore as one of the sources of the Shyok river, but Dr. Longstaff suspected that this was incorrect. [2]

After crossing the Depsang plateau we proceeded up the Daulat-beg-öldi or Pulo stream, leading to the Kara-koram pass. This valley, a tributary of the Chip-chak—which drains into the Shyok just below the snout of the Remo—rises very gently. About two or three miles before the head of the valley is reached, the Yārkand road leaves the valley bed and ascends at an easy gradient on the east side to cross the range through a low gap.

On the name Kara-korum

It is difficult to understand why this pass has received the name Kara-koram, which in Turki means black rock or boulder. There are no signs on either side of the pass of large rocks nor is the soil black. The prevailing formation is red sandstone, and the most noticeable feature near the pass is a large patch of yellow-ochreous coloured earth on its southern slope.

The name is applied by the traders to the pass alone and not to the mountains. Dr. Thomson, who, in 1848, was the first European to reach the pass, found the same in his day, [3] and Hayward in 1869 repeats the same information. [4] The latter appears to have been the first to suggest applying the name of the pass to the range, so it may be as well to remember that this extension of the name is purely due to Europeans. Shaw's views in the article already quoted are interesting and his description of the pass is very good.

System of nomenclature employed

The country at the headwaters of the Yārkand river, so far as we could discover, is never visited by Ladākhis or Kirghiz, and seems quite unknown to them; naturally therefore we were unable to obtain local names for any places away from the trade route. To avoid ambiguity, and to make this narrative clear without useless repetitions, I have adopted an alphabetical nomenclature for the various features, but this system is not to be considered in any way permanent and is used for this report only.

We reached the watershed between the Daulat-beg-öldi valley and the northern or "A" stream in two easy marches from our Depsang camp. The melting snow on the slopes above the col form two small streamlets, which enter the valley on the watershed itself, one on the eastern side and the other on the west. The col is so flat that these streams flow indifferently, according as slight obstructions deflect the flow, either to the south to join the Chip-chak and thence the Shyok, or to the north to stream "A" and the Yārkand river. On our first visit, on the 3rd July, both streams were flowing in both directions.

We were delayed at our camp here for

[2] Also Mr. R. Shaw; *vide* his paper "*A prince of Kashgar on the geography of E. Tibet*" vol. XLVI of the R.G.S. 1876, vol. XIX Journal of R.G.S.

[3] Journal of R.G.S., vol. XIX.

[4] Journal of R.G.S., vol. XL.

Stream "A"

two days by heavy snow, but on the 6th July we were able to resume our march northwards down stream "A". Next day we reached the place where, on the Atlas sheet, the stream is shown bending to the west. Here it enters a fair-sized amphitheatre or basin into which several other streams flow.

This basin is described by Hayward [5] and shown on his map as the source of the Yārkand river, but he visited the place in the middle of winter, when it was covered with snow, and his description is, in some respects, a little misleading. No glaciers are near the basin, nor are any of the hills in its immediate vicinity permanently snow covered.

Stream "B"

Entering the amphitheatre at its southern extremity is a large stream "B", that flows from the west and carries much more water than stream "A", and is evidently the main channel. On the Atlas sheet, this is shown as a continuation of stream "A" and flowing into the Shyok. The valley, therefore, must have been seen by Johnson, from whose sketches the map was constructed. [5a] But he, also, was in the neighbourhood in the winter, and it is almost certain that he made his sketch of the valley from a distance and not from an actual visit to the spot. If so, his mistake is excusable, for, as seen from afar, there is every indication that stream "A" takes a westerly course. There is a very obvious gap in the range in that direction, while to the north the mountains appear continuous and unbroken. Although I knew it was most improbable that the map was correct, it was not until I actually saw in which direction the water in stream "B" was flowing, that I was convinced that the Atlas sheet was wrong.

Stream "C"

A small stream "C" enters the basin from the east also at the southern end. Its valley is very flat and open, and leads, as we at once suspected, by a low pass to the Yārkand road, near Balti-bransa.

The basin is not a lake, as Hayward surmised, but between stream "B" and another one "D", which also enters the amphitheatre from the west at its northern end, is situated a small tarn, fed by a brook, draining the comparatively flat tongue of land lying between the two larger streams.

Stream "D"

Stream "D", which was carrying a good deal of water at the time of our visit, flows in a confined channel, and seems to be the one mentioned by Hayward in his narrative, as the source of the Yārkand river. He came from the north and only spent a day in the basin and from his description it appears that this was the stream he explored. He had not much time for extensive trips elsewhere in the basin and may not have noticed the much larger valley further south. He only mentions one stream entering from the west, and if he had seen stream "B" he would surely have spoken about it, as he was an accurate and careful recorder of what he saw.

Stream "B" flows in a wide open valley, at the head of which is a gap in the hills. Having found the existing map incorrect in this area, I decided to explore this valley; but to do so it was necessary first to bring up more supplies, as my transport only enabled me to carry food for eight days.

Three days halt close to the junction of stream "D" with the Yārkand river sufficed to bring from my main depot near the Karakoram pass enough supplies for about three weeks. During the halt Shib Lal surveyed the surrounding country while Spranger and I made two stations on the hills bordering the amphitheatre. From one of these I noticed, that, at the gap at the head of stream "B" was a glacier, but this, instead of entering the valley, as one would expect, seemed to flow across its head. I imagined that this glacier must either be the Remo, or one very close to it, so I was naturally more desirous than ever to explore this valley. Moreover, if this area was surveyed completely now, I could, after my trip down the river, return by a different route, and thus map more of the unsurveyed area.

Exploration of streams "B" & "F" and snout "E"

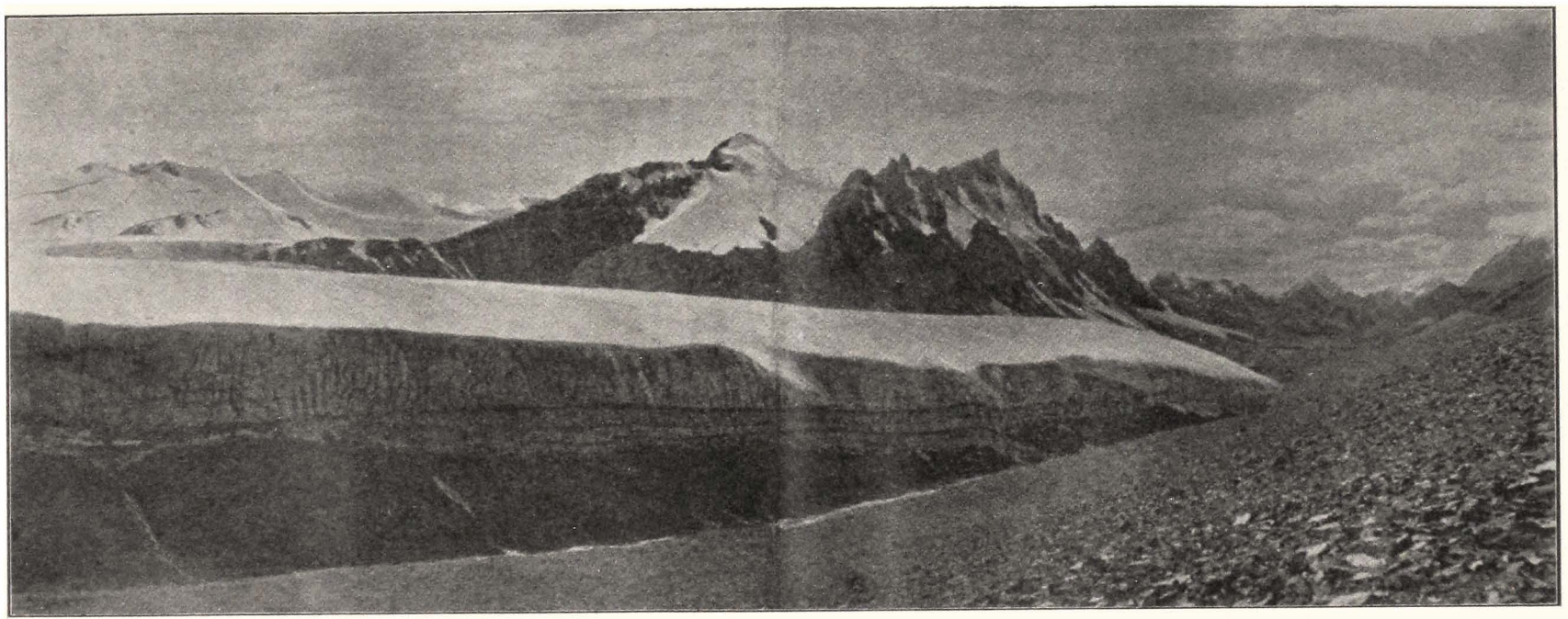
On the 11th July we started up stream "B", and on the way I climbed a high, conspicuous hill, situated more or less in the centre of the amphitheatre, and made a station on its summit. Next day, in miser-

[5] Journal of R.G.S., vol. XL.

[5a] See postscript note at the end of the report. I have recently examined Johnson's original plane-table sheet of this area.

Small lake in amphitheatre near source of Yārkand river.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.



Glacier snout resting on pass "G", and view down valley "H." (Oprang?).

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

able weather, we pursued our way upstream and reached the head of the valley, which we found occupied by the snout "E", evidently belonging to the glacier, which from the hill in the basin, seemed to flow past the head of the valley. About half a mile below this snout, another stream "F", carrying much less water than that issuing from "E", joins from the west, and we continued our march up this stream. It is only a few miles in length and we pitched camp about a quarter of a mile below a low pass "G" at its head. This gives entry to a valley "H", and resting on the south side of the pass, but not blocking the passage, is a large glacier with snouts projecting into both valleys "F" and "H", which form the sources of the streams that flow down them.

Valley "H" seen from pass "G"

I thought, on seeing the pass, that the valley "H" was the head of stream "D" and that I would be able to return by it to my depôt situated where this stream debouches into the amphitheatre; but when I crossed the pass, I found that the valley, instead of trending in a north-easterly direction as I expected, extended as far as I could see north-west to west. The valley was fairly open but of no great width and was bounded on both sides by high hills, only snow-covered on their summits, and no glacier of any sort could be seen to enter it. As I only had four days supplies with me, and thinking that I was certain to enter this valley from its junction with the main river later on, I did not go more than a mile or so down it. From the results of our subsequent surveys, I now believe, with some degree of certainty, that this valley drains into the Oprang, and is probably the source of that river, a fact which I did not suspect at the time, as Sir F. Younghusband, the discoverer and only known explorer of this river, had placed its source 30 or 40 miles further west.

A halt on the 13th July, to enable Shib Lal to survey this region, was spent by Spranger and myself in computing, and on the 14th we commenced our return journey. As I was not satisfied that we had found out everything about the glacier whose snout "E" occupies the head of stream "B", I decided to investigate it further. We first climbed the old moraine on its left (west) side, but the height was insufficient to enable us to clear up the situation. Crossing the stream issuing from the snout we passed below those of two smaller glaciers—which come down from the hills on the east but do not quite reach the big glacier—and after much hard scrambling, attained the summit of a high hill.

From here we had a most magnificent view, and the secret of the Remo lay before us. It was evident that we were on the watershed between two river systems. The glacier, one of whose branches extends into the valley "B" we had come up, has another but much longer arm on the southern side of the watershed; this is joined a little lower down by yet another,—still wider but more or less parallel to it,—and after the junction flows downward in one unbroken ice-stream to unite with the wide glacier from Collins' Pk. 7, (Pk. 50/52E). A short distance below this junction, the combined glaciers end in the snout from which the Shyok river issues.

Joint glacier origin of Shyok and Yârkand rivers

We had therefore made the interesting discovery that the Shyok, one of the main tributaries of the Indus, and the Yârkand river had a joint origin in the Remo glacier.

We made a station on the hill, and after taking many valuable observations, erected a large cairn. Three or four days later, the Remo exploring party under Dr. De Filippi on their way up the glacier saw our cairn, and also used it as a station. We did not reach our camp till very late that night, as we had to cross the stream in the dark, during the hours of its maximum flood of glacier and snow water. Next day we crossed a pass into valley "D", which Shib Lal surveyed, and on the day following arrived at our depôt in the amphitheatre.

On the 17th July, and the three succeeding days we followed the course of the main river, making stations on suitable hills and surveying the country. On the 20th, we reached a place where two large tributaries, "I" and "J", joined from the west. I felt convinced that the northern of these two streams, "J", was the one which Hayward describes as leading to a pass across the Kara-koram to Nubra.[6] We were therefore two days' march from Khufelang and the river we had been following

Streams "I" and "J"

[6] Journal of the R.G.S. Vol. XL page 59.

was without doubt the Yārkand.

The weather for the last two days had been threatening, and on the 20th it culminated in a dense haze, with continual rain and snow-squalls, that prevented us from seeing at any time further than a mile or so. The volume of water in the river was now very considerable, and streams "I" and "J" were also bringing down a large quantity, so to continue further north was almost impossible. I came to the conclusion that, as we had settled the question that we had to investigate, it was inadvisable to attempt to penetrate further downstream at this time, and so decided to return.

IV. THE RETURN JOURNEY TO THE DEPSANG PLATEAU.

To avoid re-traversing our old route, I determined to cross the river and explore a large stream "K", that we had seen flowing more or less parallel to the main river, and making a junction with it on the right bank, slightly north of the place where stream "I" joins on the opposite side.

Crossing the Yārkand river

Next day, the 21st July, we started on our return journey. We experienced great difficulty in crossing the river, and only succeeded on the second attempt, after half a dozen unladen men roped together, had found a practicable ford. The water was coming down like a mill-race, well over the coolies' waists, so that every moment I expected to see one of them swept off his feet; but by putting the biggest men on the upstream side to break the force of the current, and with all the men in a line, shouting invocations to their deities, we managed to get across without accident. A reward of four annas per man, paid to each immediately we reached the far bank, did much to make them forget their damp condition and to furnish a subject of discussion over the camp fires for the next few days. The weather still remained unfavourable, for during the morning the snow and rain squalls still continued, though during the afternoon conditions somewhat improved.

Streams "K" & "L"

The following day was overcast, but no rain fell, and we reached the head of stream "K", crossed an easy pass, and entered a valley "L", which evidently joined the river near a big bend about twelve miles below the amphitheatre. We did not reach the river that night as I had hoped, but were forced to halt at nightfall some four or five miles short of the junction.

Stream "M"

I now decided to try and find some way into the valley, which the Yārkand road follows after crossing the Kara-koram pass. Next day, therefore, I sent Lance-Naik Lal Bahadur with a moiety of the coolies to fetch the remaining supplies from our depôt in the amphitheatre; while with the rest, carrying double loads, I made a short march and camped a couple of miles or so up the stream that I intended to explore first for a pass leading to the Yārkand road. This stream, "M", joins the river close to its junction with stream "L". Lal Bahadur did not arrive in camp that night as expected, but early next morning—the 24th July—one of his men was seen upstream of our camp, and from a distance shouted that Lal Bahadur with his party was camped a few miles away. As our route led towards them, Lal Bahadur was instructed to join us on the march. It appeared that he, thinking we would camp further upstream, had attempted a short cut. Instead of coming down the river and then going up stream "M", he ascended the valley "C" and by a side nala crossed a pass into valley "M" by one of its tributaries; but the distance proving further than he expected he had not been able to reach our camp before dark.

The Yārkand caravan route reached

I made a station on the way, and it was late in the afternoon before I followed the track made by our caravan. On reaching the head of the valley, I was delighted to find that it was not blocked by a glacier, as I feared it might be, but an easy pass gave access to an elevated valley, which evidently drained into the stream alongside which the Yārkand road passes. More or less on the pass itself was a fair sized lake. I had only six days' supplies left, and as, even if we found a pass at once, it was at least three days' march from our camp of the 23rd to our Kara-koram pass depôt, there was not much latitude for delays. My anxiety was therefore much relieved at finding a pass on the first attempt; and it was completely allayed on arrival at

camp, when I heard that one of the coolies, who had previously been to Yārkand, recognised a rather conspicuous hill, some ten miles distant, as being close to the trade route. All anxieties about supplies being ended, I decided to halt the following day (the 25th July) to enable Shib Lal to survey the valley and Spranger and I to make a triangulation station. Any points fixed here would be very valuable later on, when we would be marching along the Yārkand road on our way northwards.

On the 26th we resumed our march. The weather was bad, rain and mist preventing any survey work, but this was not of much importance as we would have an opportunity of doing it later. We camped that night at Balti-bransa, a regular halting-place on the trade route, having no difficulty in recognising the road, when we reached it, by the skeletons of transport animals which bordered it.

Balti-bransa.

Next day we arrived at our old main depôt camp of the 3rd to 5th July, near the Kara-koram pass. Here I proposed to halt a day, and make a station on one of the neighbouring hills, as I had not been able to do this at our first visit, owing to bad weather. But at night heavy snow fell, and continued the following morning. As we would cross the pass again later, I did not think it worth waiting for the weather to clear, so decided to continue our march towards the standing camp on the Depsang. As this route had been already surveyed, the bad weather did not matter from that point of view. Just as we were leaving camp, it was reported to me that one of the coolies was sick, and would be unable to carry his load. His condition did not seem serious however, as when I spoke to him he stood up and said he was capable of marching with us, if relieved of his load, which accordingly was distributed amongst the other men. Shortly after our arrival that afternoon at camp at Pulo, I heard that the man had died while on the march. This untoward event was as much a surprise to me, as to his companions, some of whom at once returned to watch over the body during the night. A halt on the 29th was imperative to allow the men, who were much upset, to make the necessary funeral arrangements; so the weather having improved, Spranger and I occupied ourselves in making a station on one of the adjacent hills.

On the 30th, to avoid traversing ground already surveyed, we struck up the side stream, which joins the Daulat-beg-öldi valley from the west at Pulo, and camped about ten miles from the junction. This stream carries much more water than the one emanating from the Kara-koram pass, and its bed is absolutely covered with fossils, principally ammonites, some of which are of great size. Shaw mentions [7] that several independent witnesses told him that up this stream there is a way over a difficult glacier pass, by which Khapalu in Baltistān may be reached in ten days. We heard nothing of this route when we were in the neighbourhood, but it is interesting in connection with the relics of previous travellers found by the Workmans on the Siā-chen glacier. This route, which seems feasible, would have to follow the Remo glacier to the Tārīm-shahr affluent of the Sia-chen and thence over the Sīa-la or Bilaphond-la.

Route *via* Remo and Siachen glaciers to Khapalu.

Next morning, after going up a side valley leading westwards and crossing the range at the head of it, the caravan went down the adjoining valley and camp was pitched on the banks of the Chip-chak; while Spranger and I kept to the north along the crest, till we reached its highest point, where we made a station.

A halt on the 1st August for supply purposes was usefully employed in computations. On the 2nd, we started up a large stream "N", which joins the Chip-chak near our camp, hoping to find its source on the main watershed. The weather did not look very promising when we started, and at about half-past nine snow began to fall. Spranger and I, pushing on ahead of the caravan, soon reached the apparent head of the valley, but owing to the snow we could not determine whither the pass led. There was neither water nor *būrtsi* at this place, and as it seemed unlikely that the coolies would get much further, I decided to return and stop the caravan at a place where the stream lay in a deep ravine and made a junction with another entering through a gorge from the west. This place

Stream "N"

[7] Journal of R.G.S. Vol. 46. 1876. *A Prince of Kashgar on the Geography of E. Tibet*, by R. Shaw.

was more or less at the limit of the scanty vegetation which the valley contained. A short break in the storm enabled us to pitch the tents, but no sooner was this done than the snow recommenced, and continued for the next seventy-two hours without a break. Computations kept our minds from dwelling too much on the weather conditions, and unpleasant as these were with us, we realized that the Remo party, which we knew was more or less at the highest point of the glacier, was in a far worse plight.

On the 6th August, the storm having cleared, we made a fresh start, and we then found that the western stream was the main one, a fact we had failed to realize originally, owing to the snow-storm. This curious feature of a stream, for no apparent cause, suddenly leaving a comparatively open valley to cut a deep and narrow gorge through the adjoining range, is a fairly common one in this immediate neighbourhood, as we came across more than one example of it. We, however, continued up the valley to the place which Spranger and I had reached on the 2nd, and dropping steeply down on the northern side of the pass, rejoined the main stream. We continued up this till we reached its debouchure from a gorge, evidently near its source, and here we camped.

View from Shyok-Yārkand river watershed

Next day, sending the coolies back to collect *būrtsi*, of which none grew near our camp, Spranger, Shib Lal and I climbed a high hill in the vicinity, in order to make a station. The weather was fortunately very fine, and the atmosphere absolutely clear. From the summit—which was the highest point yet reached by us and just under 20,000 feet in altitude—it was evident that we were on the Shyok-Yārkand river watershed, and we were rewarded for our long and rather tiring climb by the most magnificent view imaginable. K², the Gasherbrums, and Teram-kangri to the west, with the high Sassir peaks and even more distant ones to the south, were prominent objects; whilst to the north, amongst innumerable snow peaks, we recognised many that we had fixed during the preceding month. To the east, very distant mountains were visible, and, in fact, we were surrounded by one gorgeous circle of range upon range of snowy heights.

Immediately below us to the west, at the head of the valley up which we had marched, was a low pass, on the western side of which two glaciers sloped down from a high snow peak. Between the snouts of these glaciers, which seemed almost to rest on the pass, was a small lake. After finishing my observations, I returned to the camp *via* this pass, to satisfy myself of the actual direction of the glacier streams. The lie of the hills and valleys in this region is so uncertain, and I had been so often deceived by the unexpected course taken by them, that I knew that nothing less than actual inspection on the spot would ensure that no mistake was made. I found that the northern glacier of the two had dammed the valley, so forming the small lake, into which the southern glacier drained. I followed the stream issuing from the northern one far enough to satisfy myself that it flowed into the Yārkand river.

Only a few miles of the watershed now remained to be mapped; we therefore retraced our steps next day down the valley ("N"), and passing below our point of entry from the pass crossed on the 6th, effected a passage of the range to the west through a gap in it. We then skirted the northern side of an open high-lying valley, and camped that night in another large valley "O". This led northwards and, I hoped, to that portion of the watershed as yet unsurveyed.

Stream "O"

The following day, the 9th August, we started up stream "O", and after a short march reached its head. As the weather was threatening, Spranger and I at once climbed the highest of the surrounding hills, intent on making a station. This hill, though only fifty feet or so lower than the one we had ascended two days previously, proved much less arduous, and when I reached the summit, though most of the surrounding hills were still visible, a big snow-storm could be seen approaching from the south. The hill was not, as I had hoped, on the watershed, as a large stream drained from its north-western slopes towards the Remo, and the main watershed was further north. An hour later, as Spranger, with the coolies carrying the theodolite, reached the summit, the storm burst. As it was still early, we waited, in the hope that the weather would improve. Fortunately after an hour

or so the snow gradually ceased, and soon most of the peaks again became visible. I was able to take all the observations required and we reached camp before dark.

Next day we halted to enable Shib Lal to survey the valley, while the coolies went back to collect *bārtsi*. I sent the two Gurkhas over the pass into the northern valley, to see if it contained fuel, while Spranger and I, as usual during halts, spent the day computing. The Gurkhas on their return, reported that the valley "grew nothing but stones". On the morning of the 11th the weather was again bad and snow was falling. We had but three days' supplies with us, and were a long day's march from our depôt, so our stock of food would only suffice for one march into the valley and back. In view of the unsettled state of the weather, this did not seem sufficient. Another triangulation station in this neighbourhood was not essential, and though I would have liked to explore this valley myself, I decided to divide the caravan, as this appeared the only sure method of completing the survey of this, the one remaining, gap along the watershed between the Remo glacier and the Kara-koram pass.

Accordingly, giving Shib Lal all the supplies we had, and the two or three loads of *bārtsi* brought up the previous day, with sufficient coolies to make light loads, Spranger and I, with the remainder, carrying the rest of the equipment and consequently very heavily laden, made a forced march to our depôt. This arrangement gave Shib Lal ample supplies for more than a week, which would suffice for the work required, even if he experienced bad weather. Our coolies, spurred by the knowledge that unless they reached the depôt that day they would have no evening meal, marched very well, and we reached our destination—the camp of the 1st August on the Chip-chak—before night-fall.

Return to Depsang plateau

On the 12th August, we arrived at the standing camp on the Depsang, receiving a warm welcome from the two meteorologists, who had spent the whole period there, and from the geologists who had returned there about a week earlier. The following day the Remo party arrived, and two or three days later Shib Lal, who had satisfactorily completed the survey of the area he had been left to finish.

V. THE SECOND HALT ON THE DEPSANG PLATEAU AND THE MARCH TO SUGET

Ghulam Rasul, our caravan-bashi, had left the Depsang camp on the 30th July for Shahīdulla to make arrangements for transporting the entire camp to the northern side of the Kara-koram pass, and a letter had been received from him saying that he would return with the necessary baggage animals on the 19th August. This interval Spranger and I utilized in computing the more important results of our observations.

First news of the Great War

Owing to landslips on the Shyok valley road, we had not received any post for six weeks, so were all delighted when a mail-runner arrived on the 16th. Our joy however was much damped at the news it brought of the outbreak of the European war. This information was conveyed in a brief telegram, sent to me from India, which had reached Leh after our post-runner had left, but which Captain Gabriel had sent on by a mounted man to overtake our mail.

Return of Italian officers and Gurkhas.

When the telegram had been despatched from India, England's action was unknown, and I was told to remain with the expedition pending further orders. The three Italian officers with us decided to return to Italy at once. They—Commander Alessio, R.I. Navy, Lieut. Antilli, R.I. Engineers, and Professor Alessandri, an officer of the reserve—accordingly left for Leh next day, and I sent the two Gurkhas with them. Much as I regretted parting with the latter, I did not feel that I was justified in detaining them under the unprecedented circumstances that had arisen. Always cheery, making light of all difficulties or discomfort, they earned golden opinions from all the members of the expedition. I regret to add that both men were killed during the Great War.

The sudden departure of our comrades entailed some alterations in the arrangements, but Dr. De Filippi decided to adhere to the

original programme of work as far as possible. I received the honour of being appointed second in command in place of Alessio, but I am thankful to say that no untoward accident to our leader necessitated my acting in that capacity.

Final crossing of Kara-Koram pass

The transport having arrived on the 19th August, we left the following day and all proceeded together for the first two marches as far as Baksam-bulak. When crossing the Kara-koram pass, fortunately this time in fine weather, I made a station on the hill immediately south of, and about half a mile from, the pass, and another on the pass itself, close to the pillar erected to the memory of the explorer Dalgeish. The height of this latter station, derived from my triangulation, is 18,270 feet. This value is some 400 feet less than that recorded on the most recent maps, but is almost exactly the same as that given by Johnson in 1864. Baksam-bulak, which is shown much out of position on the existing maps, was not reached by the transport till after dark, and the surveyors did not arrive till next morning.

Division of the party

Here our party divided—Dr. De Filippi, Ginori, Abetti and I, with all the heavy technical kit proceeded to Suget, *via* the pass of that name. Spranger and Petigax, with Jamna Prasad, followed the direct caravan route, *via* Ak-tāgh to Khufelang, taking with them the main bulk of the supplies. Spranger and Petigax were to remain at Khufelang until I joined them, while Jamna Prasad, taking with him the supplies for Dr. De Filippi's party, was to go three marches further down the Yārkand river to Kirghiz-jangal, at the junction of the road from Suget, and there await the arrival of that party. Shib Lal was to proceed by a valley situated between "K" and "M" streams and the route followed by Spranger and Petigax. This valley drained into the Yārkand river about a day's march above Khufelang. From the junction he was to survey upstream to the neighbourhood of "I" and "J" streams, the limit of our explorations in July. It was my intention, after reaching Kirghiz-jangal, to go to Khufelang and, with Spranger and Petigax, to join Shib Lal and then explore "I" and "J" streams.

I will deal with my experiences first.

Darwāz-sarigh-ôt and Ak tāgh

The division of the various loads amongst the three parties took a considerable time, so we did not leave Baksam-bulak until after midday on the 22nd August, and only marched as far as Darwāz-sarigh-ôt, a camping ground on the road to Suget, which here lies slightly east of the main Yārkand track. From this place I made, on a cavalry sketching board, a traverse of the route to Suget. Next day crossing the wide open plain, and still keeping but little east of the Yārkand road, we passed the camping ground of Malik-sai, and went up a tributary "P" of the Yārkand road stream. A short distance above the junction, the stream bifurcates to flow round a yellowish sandstone hill, which rather inappropriately, is called Ak-tāgh (=white hill, in Turki). We ascended the eastern branch; the other keeps to the north of the hill and makes its junction with the Yārkand road stream close to the camping-ground of Ak-tāgh. The gradient above the bifurcation is very gentle, and the valley is open. About ten or twelve miles above Ak-tāgh is the camping ground of Chibra, a forlorn and desolate spot in rather a narrow part of the valley. Here we were joined by the two geologists, Dainelli and Marinelli, who had left the Depsang camp two days before us to examine the ammonite-fossil valley near Pulo.

Stream "P"

Next day, we continued to follow stream "P". Its valley again opens out considerably after leaving Chibra, but still keeps its gentle slope, and, after marching for about five miles, we reached the pass. Snow peaks, of no great height, flank it on both sides, and the view is very restricted. Abetti and Ginori took hypsometrical measurements on the pass, but the results of these observations have not yet reached me. The descent on the northern side is abrupt for the first thousand feet or so, but the road surface remains good.

Suget-karaul

Soon after crossing the pass, the limestone rocks, which had been the prevailing formation since leaving Murgo in the Shyok valley, gave place to granite, and this persisted until we again crossed into the Yārkand valley. Following the stream from its source on the pass, the valley of which is fairly open throughout, we reached, after ten miles, the grazing-ground of Suget, and

some three miles beyond that, Suget-karaul (or fort), situated on the left bank of the Kara-kāsh river.

Sir Aurel Stein's map shows two parallel ranges, about five miles apart, between Ak-tāgh and Suget. This region is on the extreme margin of his map, and the country has evidently been sketched from a distance. There is only one range, and the southern one of his map is non-existent.

An obvious pass exists between the valley we followed from Suget pass, and the Kulshish-kun valley which leads from Suget to Shahīdulla; this pass is shown on the French 1/M map.

Suget-karaul is situated at the place where the Sanju route from Leh to Yārkand leaves the Kara-kāsh valley. Its square mud fort is occupied only in the open season, when it is the residence of a minor Chinese official.

The Kara-kāsh river, here beginning to cut its way through the K'un-lun range, flows in a deep gorge. The wind, which rises every afternoon and continues till midnight, blows with great violence. The granite rocks are thus much weather-worn, and the atmosphere of the valley, laden with the sand raised in great clouds by the wind, becomes in the afternoon quite opaque.

Astronomical, pendulum and magnetic work at Suget

At Suget, Abetti made pendulum and magnetic observations. He also observed for latitude and received the wireless signals from Lahore for determination of the longitude. Ginori and I assisted him in some of this work, and in addition I executed a small triangulation in the vicinity, starting from a measured base, in order to provide material for computing the orographical correction for the pendulum observations.

Professors Dainelli and Marinelli left us on the 26th August, two days after our arrival at Suget, to proceed direct to Italy, *via* Kāshgar.

VI. FURTHER EXPLORATIONS IN THE YĀRKAND VALLEY

The Kos-bēl pass.

We completed our work on the 2nd September, and left next day. Crossing the Kos-bēl, a low and easy pass, we camped that night in a grassy valley, known to the Kirghiz as Kulshish-kun. Kaltis, the name given on Stein's map, was not recognised by the men we had with us. This valley, which joins the Kara-kāsh river at Shahīdulla, is well described by Hayward, but the wild yak, which he says were then regularly found on the Kulshish-kun grazing-ground, were conspicuous by their absence. Continuing our march on the following day along the open valley, we camped that night at Kara-jilga, where the main valley bends sharply to the north and a small one enters from the east. On the 5th September, shortly after leaving camp, we passed, high above the road, a large and very conspicuous glacier, which descends from a snow peak and fills up a side valley. About six miles from our camp, the road leaves the main valley and follows a small tributary, half a mile long, to the pass. At the junction of this stream, the main valley bends towards the east, its stream rising from a glacier which descends from a fine snow peak to the east of the pass.

The slope of the road from Suget to the pass is throughout very gentle and easy, but the descent on the west to the Yārkand river is entirely the reverse. Unfortunately, the day was very hazy, and the view from the pass, described by Hayward as very fine, was denied us. The name given on Stein's map for the pass—Kök-yārt-dawān—was the one used by our Kirghiz transport-men; those given by Hayward and Younghusband, Kirghiz and Sokhbulak respectively,—the latter possibly more correctly spelt Sorokh-bulak (="cold spring" in Turki)—are derived from the camping-grounds on either side of it, the former in the Yārkand valley and the latter on the Shahīdulla side. The height of the pass was observed hypsometrically by Abetti. To the west of the pass, the granite gives place to a schist, much laminated and crushed in places. After descending some 3,000 feet or more in a few miles, keeping to the same rocky valley the whole way, we reached, on the 6th September, Jamna Prasad's camp on the banks of the Yārkand river, about three miles above the camping-ground of Kirghiz-jangal.

After we had left Baksam-bulak, Jamna

Prasad had accompanied Spranger's party, and had surveyed the road, and to some distance east of it, as far as Ak-tāgh; between which places Spranger had made four triangulation stations. The march from Ak-tāgh to Khufelang, accomplished in one day, was too long to allow of much surveying; during a halt however at the latter place, he had visited a high hill in the vicinity, and from there he had been able to sketch in a good deal of the surrounding country, while Spranger, who had accompanied him, made a station on it.

Jamna Prasad's road survey to Ak-tāgh

From Khufelang to Kirghiz-jangal, bad weather put a stop to all his survey work, but while awaiting our arrival he had mapped the stream leading from the Kök-yārt-dawān and the ground in the vicinity. The river here runs in a very deep gorge, between rocky and almost unclimbable precipices, and surveying is very difficult.

On the morning after our arrival at Kirghiz-jangal, Dr. De Filippi with Ginori, Abetti and Jamna Prasad proceeded downstream with the intention of crossing the Aghil pass leading to the Oprang valley, which they were to explore, while I went upstream towards Khufelang.

The following account of the survey work done by this party is due to Abetti, who writes—

'As Dr. De Filippi wished to travel as fast as possible, it was decided not to survey during the march, but to start mapping at Bāzār-dara, a place situated on the right bank of the Yārkand river. This survey was to be based in the first instance on astronomical co-ordinates, but it was hoped to connect it, later on, to the triangulated peaks of the Kara-koram range.

Astronomical observations as basis for survey from Bāzār-dara

'Arriving at Bāzār-dara on the afternoon of the 9th September, a station was selected in the bed of the valley on the right bank of a torrent—the Bāzār-daryā—which here joins the Yārkand river, and about fifty metres north of the old fort. From this station, latitude observations were taken that evening with a sextant, and at the same time a comparison made of the eleven chronometers carried by the expedition. On the 10th, time observations were taken, with the same instrument, to the sun both in the morning and in the afternoon. The computation of these observations gave the following provisional co-ordinates for the position of the Bāzār-dara station—lat. 30° 24′ 0″, long. 76° 53′ 3″ E. of Greenwich. On the same day a small base was measured on an alluvial terrace above the village, and connected to the astronomical station. The azimuth of the base was determined from sun observations from both ends and proved to be 56° 55′ 0″. The readings of two hypsometers gave a provisional value for the height of the station as 3,680 metres (12,070 feet).

'With these data Jamna Prasad commenced the survey, only to be interrupted after three marches. Notwithstanding many attempts, the Yārkand river proved unfordable at Kharol, where a crossing had to be made to the left bank in order to enter the valley leading to the Aghil pass. Dr. De Filippi was therefore forced to give up his intention to explore the Oprang valley. Hypsometrical observations were taken at Kharol, giving 3,470 metres (11,385 feet) as the provisional height of this place.

Exploration of Oprang abandoned.

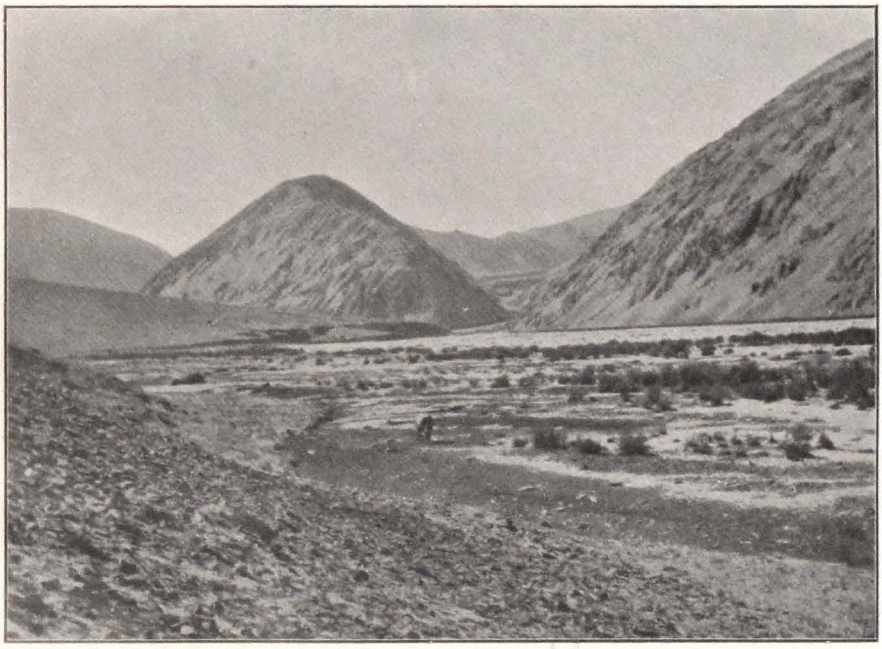
'Returning to Bāzār-dara on the 15th September, local time was again determined from sun observations. During the ensuing march to Yārkand the survey was continued, which it was originally intended to close at Kök-yār; but as cloudy weather prevented any astronomical observations being taken there, the survey was carried on to Karghalik. This place was reached on the 24th September, where time and latitude observations were successfully made. The provisional values of these observations give lat. 37° 52′ 2″, long. 77° 32′ 0″ E. of Greenwich, as the co-ordinates of the station there. Hypsometrical observations were taken on the summits of the four passes—Kukalung-dawān, Takhta-koram-dawān, Ishak-ārt-dawān and Ak-koram-dawān—crossed between Bāzār-dara and Karghalik.'

Survey closed at Karghalik

To revert to my experiences. Much water was coming down the river, and as Jamna Prasad reported that the volume decreased as the day progressed, I delayed my departure till after that of the other party. I hoped to reach Khufelang in two marches, but owing to this late start I did not reach my proposed camping place that

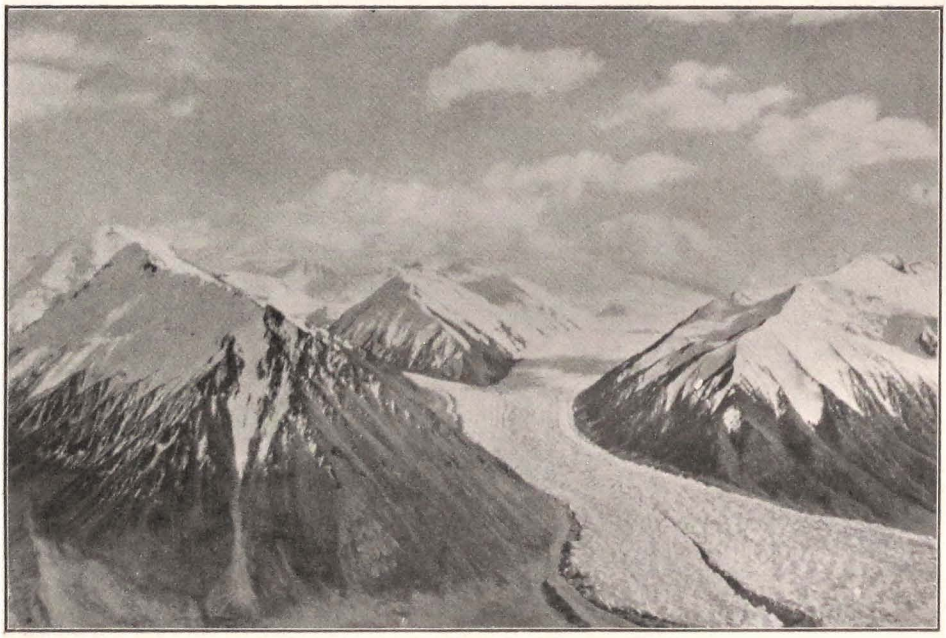
Upper Yārkand gorge

Terraced slopes on right bank of Yārkand river near Khufelang.



The Yārkand river and valley leading to the Yangi-dawān. *Vide* page 23.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.



Glaciers draining into stream "I" near its junction with Yārkand river.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

day. Much time was also lost at each of the nine river crossings in searching for practicable fords. At the best, the water reached well up to the ponies' shoulders; at one place they all had to swim a few yards, at another a pony fell, and was only rescued from drowning after much difficulty. In our soaking condition, we were glad to reach at sundown an open place where we could pitch camp.

For the whole length of this march, the river flows in a deep gorge with cliffs on one side or the other, which deflect the road to the more open side. The current at this time of the year is very swift, and the passage of the river difficult.

Khufelang reached

Next day, the 8th September, leaving camp before sunrise, I reached Khufelang about five p.m., where I found Spranger and Petigax installed. During this march the river had again to be forded nine times, but none of the crossings were as difficult as those of the preceding day, as the valley is more open, and the stream, generally in several channels, is consequently easier to negotiate. Shortly before Khufelang is reached, the hills recede somewhat, and the lower slopes assume a terraced aspect; at one place I counted seven distinct levels. No large stream joins the Yârkand river between Kirghiz-jangal and Khufelang, and of the minor ones, at the time I passed, only one or two were bringing down any water, and that, in a mere trickle.

Bad weather had prevented Spranger from doing any triangulation after Jamna Prasad's departure, and he had employed his time in computing.

The ponies strayed during the night following my arrival, and our departure was delayed next morning till about noon, when half of them were brought back. Loading these with the most necessary material, we started upstream, but naturally could not go far, and pitched camp a little above the place where the first large valley joins on the left bank. Early on the 10th, Spranger and I climbed a hill on the right bank, just above the camp, to make a station. A little later, the remaining ponies having arrived, Petigax led the caravan to our old camp of the 20th July at the junction of stream "J" with the main river. Here it was that we had arranged Shib Lal should await us, but Petigax, not finding Shib Lal's camp at the appointed place, continued upstream till he found it at the junction of stream "I".

Spranger and I did not finish our work on the hill till late, and on arrival at the rendezvous about sunset, were rather in a quandary at not finding the camp where we expected it. No tracks were seen leading up stream "J", we therefore proceeded up the main river till it became dark, still without coming across any tracks of the caravan. We were just giving up all hopes of finding the camp that night, when we saw lights in the distance, and arriving there heard the reason for the misunderstanding.

Exploration and survey of Stream "I"

Shib Lal was not at his camp, but from the two men he had left there, we learnt that he had gone up stream "I" on the previous day, and was expected back on the morrow. We therefore halted a day, but as he had not arrived on the following morning, the 12th, we started up the valley, and after marching five miles or so, met him on his way back. He told us, that having finished the survey of the area allotted to him, and not liking to waste time, he had started work in the tributary valley. However, weather conditions being unfavourable, he had been unable to accomplish much.

The survey of the two streams "I" and "J", as far as their sources, being our programme, we continued our march up the valley. This is open and much less water was coming down now, than during our first visit two months earlier. We followed it up to a point, some three or four miles below two glaciers, where we pitched camp. These glaciers, descending from high snows on the right bank, appeared to advance right across the open valley and block it. I went on to investigate them and to find a practicable road for our transport. Reaching the first, I saw that it entirely dammed the stream-bed, spreading across the valley bottom, with its snout resting against a rocky cliff on the left bank. On the slopes above the cliff, however, there was a game track, along which our ponies could travel. From here I could also see that the second glacier did not stretch entirely across the valley, and would not present any obstacle to our forward march.

Next morning, the 13th September, Spranger and I climbed a hill to make a tri-

angulation station, while Petigax led the caravan upstream, and pitched camp just above the southern or second glacier. From their moraines it is evident that at one period both these glaciers were of much greater extent. The southern of the two had also previously extended right across the valley bed, and its terminal moraine now forms a dam, through which the stream has cut a narrow passage. The lake, created by this dam, has been gradually silting up, and now only exists when a large flow of water results from the melting of the snows. During times of lesser flow, as was the case when we visited it, the stream above loses all its velocity and the greater part of the water disappears in the mass of detritus and sand, only a small portion escaping by the channel through the moraine dam.

Starting early the following morning, I intended to make a long march, hoping to reach near to the source of the stream, which I expected to find in the northern slopes of the Kara-koram. After marching five or six miles, however, our further advance was stopped by a narrow gorge, full of immense boulders, apparently quite impracticable for ponies. A short climb up the steep slopes of the valley revealed the fact that the gorge had been formed by the stream cutting its way through the terminal moraine of another glacier, which had previously also blocked the channel. The glacier, which had formed this moraine, must have been very large and high up on the slopes above, a small glacier now rests on the top of the old moraine.

Sources of stream "I"

Beyond the gorge, the head of the valley was in sight. We therefore pitched camp two miles below the obstacle, at the junction of a side nala on the right bank. We spent the rest of the day exploring the stream above the gorge, which here divides, although for about half a mile the two branches follow parallel and westerly courses, some few hundred yards apart; they are separated from each other by a long narrow tongue of rock, about 100 feet high, protruding from a high-lying plateau. The southern branch then makes a big bend and, taking a southerly direction through a deep and narrow gorge, has its source in an ice-field formed by several glaciers flowing from the northern slopes of a group of high snow peaks. This ice-field has also an outlet to the south and therefore follows the general course of glaciers in this neighbourhood by having outlets into two separate valleys. The northern branch keeps roughly to its westerly course, also in a deep but more open gorge, till it reaches a low gap in the watershed on which to the south, rests a long glacier, descending from another group of snow peaks. Like the glacier at the source of the other branch, this, too, sends tongues into the valleys on either side of the pass. This latter is quite practicable for animals, as the glacier neither blocks it nor the valley, but rests on the southern slopes, leaving an easy passage. It is very similar to the pass "G" near the Remo glacier snout of the Yārkand river. The gorge above our camp undoubtedly forms a serious obstacle to animal transport, but a way could doubtless be found through or round it, if necessary.

Observations from station near head of stream "I"

We halted next day, the 15th September, so that Shib Lal could survey, and Spranger and I made a station. A long climb eventually brought us on to a spur, emanating from the western watershed, and though some 1,500 or 2,000 feet below the crest, this gave us the view we required. This station proved to be the highest we made during the expedition, just over 20,000 feet in height. The view to the south was unfortunately obscured by clouds, but during momentary breaks there was visible, south of the range from which stream "I" rises and separated from it by a wide valley, another high snowy range. I managed to observe a high peak on this range, and subsequently identified it as No. 23 of the Workman's Siā-chen triangulation (height 24,240 feet). This proves conclusively that this southern range is the Kara-koram, and that stream "I" rises from a more northern one. The valley between these two ranges is most probably the Oprang.

From our station, we also noticed two small lakes some distance up the side nala, at the junction of which with stream "I" our camp was pitched. Previous experience led me to surmise, and subsequent investigation proved, that these lakes were situated on the watershed. Beyond the lakes, the nala drains in a southerly direction and probably leads into the same valley into

which the southern outlets of the glaciers flow. This lake-stream probably affords the easiest passage from stream "I" into the broad valley between the two ranges mentioned above.

Next day we began our return journey, but Shib Lal remained one day more to finish the survey of the sources. It was desirable to make a triangulation station near the junctions of streams "I" and "J" with the Yārkand river, but as the detail survey thereabouts was complete, Shib Lal's presence was unnecessary, and his time could be better spent at the headwaters of the stream. On the day following we reached our July camp at the junction of stream "J" with the river, Spranger and I making a station en route. From this hill we had a splendid view, except towards the south, the Kara-koram range still being enveloped in clouds.

The "red range"

The weather on the morning of the 18th September was again bad, but we climbed a hill on the left bank of the river near our camp and made a station. The weather improved as the day progressed, and I was able to take more observations than at one time seemed likely. A very noticeable feature in the landscape seen from this station is a dark red range (of sandstone I think) which extends in a north-westerly–south-easterly direction for some distance on both sides of the Yārkand river. The higher portions of the range were snow-covered, but are only about 20,000 feet in height. On returning to camp, I found Shib Lal had arrived, having satisfactorily completed his survey.

Stream "J"

On the 19th September, in dull and threatening weather we started up the northern stream, "J". This issues from a rather narrow and deep gorge to join the main river, and is here separated from stream "I" by a long tongue of rounded hills, which I think must be a very ancient glacier moraine. Its rocks are almost entirely granite boulders embedded in a fine yellow clay and must have been transported some distance as the local formation is limestone. It is of course possible that the Aghil range, which I did not visit, is of granite formation, but the nearest granite that I saw, was on the K'un-lun range.

The gorge, instead of opening out as we expected, continued to the source of the stream. The water flowing down it was still considerable in amount, and as the only passage is by the bed of the stream, one soon lost count of the number of times one had to ford it. The water reached well up to the coolies' waists, and it is no exaggeration to say, that on this and the three succeeding days, the men had to wade across this stream of glacier-fed icy water at least four hundred times; that they did so without a complaint speaks volumes for the pluck and hardihood of our Baltis and Ladākhis.

Its difficult gorge

Camp was pitched that night on a small patch of gravel, under a cliff, in the river bed. A dry torrent in the vicinity afforded a rough approach to the slopes above where a small quantity of '*būrtsi*' was found. The root of this served us as fuel, and the ponies got what nourishment they could from the dessicated tops of it. Next day, with worse weather and under similar conditions as regards the track, the march continued. The ponies now began to show signs of the hard work that they had undergone during the last month, and on this day three were quite unable to carry loads.

In places the slopes above the gorge opened out slightly and the bed of the stream widened, but it was still confined between almost continuous walls of rock. Narrow gorges were frequent and, except in one place where, high up on the slopes above, a patch of dry grass was noticed, the hills were entirely bare of vegetation. This valley was the exact antithesis of the one traversed the previous week. There, grass was plentiful, game-tracks were numerous and the lower slopes gentle; here was an utter wilderness.

We went on, hoping to find a camping ground, where at least '*būrtsi*' would be available, but finally we were forced to halt at sunset at the end of a deep and narrow rocky gorge, below which a large affluent joined on the left bank. I climbed on to the slopes above to view the situation. The stream continued for another eight to ten miles in the same deep gorge, and took its rise from a large snow-field or glacier descending from a snowy range, which certainly could not be the Kara-koram. Like the first, this stream therefore did not drain

from the Kara-koram, as expected, but from another and more northern range. A snow-storm soon drove me down, and camp was pitched under conditions that could hardly be more depressing.

Numberless crossings of a stream, waist-deep in icy snow-water, a long and very tiring march, and now, falling snow with no prospects of any fires—could anything be more cheerless?

Imagining this valley, like the previous one, would contain fuel, and owing to the necessity of limiting the weight of the baggage as much as possible, on account of the poor condition of the ponies we had left the 'primus' stoves at the camp near the junction, and had to suffer accordingly.

The Kirghiz pony men managed to find a few grassy roots, with which we warmed up a little soup for dinner and tea for breakfast, but the rest of the camp had nothing but uncooked food. Shib Lal spent a most uncomfortable night in the open, as he was delayed by his survey work, and only reached camp in the morning.

To proceed further under the circumstances seemed impracticable. Our pony transport was rapidly losing strength from lack of food, and the chances of finding vegetation higher up the valley were hopeless. We had made two long marches, almost more in water than on dry land, and I felt that the coolies should not be asked to go further under the conditions obtaining. The case was earnestly debated by the three of us, and we reluctantly decided that a return was inevitable.

It snowed most of the night, and several inches of snow lay on the ground in the morning, though the sky was cloudless, so, seizing the opportunity of doing some triangulation, immediately after a very unsatisfying cold breakfast, I climbed the hill, which I had partially ascended the previous evening. This was on the left bank, and from the height I had then reached I could not see whether the stream divided or not below its glacier source. To make sure of this point, should it be invisible from the summit of my hill, Spranger crossed the stream and climbed about 1,000 feet above its bed. From this point he saw that the stream had two branches, with one coming from a south-westerly direction.

The hill, which I climbed, proved higher than I anticipated, but from its summit I had at first a very good view. Clouds had already begun to form, and before the coolies arrived with the theodolite and plane-table, many distant peaks were blotted out. The view to the north and north-west remained clear for a longer time, and I noticed that the red range, mentioned earlier, extended much further west than I had previously seen. I could not recognize any of the peaks at the source of stream "I", which I had observed on the 15th, but this was hardly to be expected as the streams were divergent. Before my observations were complete, a heavy snow-storm, which had been approaching for some time, enveloped the hill, and with no prospect of the weather clearing I was forced to leave the work incomplete.

View from hill in "J" valley

Shib Lal, who was with me, had time to sketch the sources of the stream, and we both agreed that the two branches—we could also see the division—did not break through the range, but had their sources on it. I also satisfied myself that all the drainage for ten to fifteen miles at least to our west and north-west flowed into stream "J" and that for this distance no tributary of the Yārkand river, flowing from a south to north direction, such as is shown on all existing maps, has a source in the Kara-koram. The red range mentioned before probably extends as far as Bāzār-dara, and I think that only the water draining the northern slopes of this range flows direct into the Yārkand river.

Sources of stream "J"

Petigax had started in the morning with the transport downstream, and camp was pitched that night, the 21st September, in the river bed below the inaccessible patch of dry grass, which we had noticed when on our way upstream. My intention had been to halt here a day and make a station, but the snow-storm continued all night and snow was still falling in the morning. Triangulation was out of the question, and we could not afford to wait for the weather to clear, as there still remained a considerable amount of more important work to be done along the Yārkand river between the junction of stream "J" and Khufelang. Spranger, Petigax and I therefore continued our march downstream, leaving Shib Lal behind to complete the survey of this stream and join us later.

On the 23rd September we passed our

camp at the junction, and picking up the stores left there, we pursued our way down the Yârkand river and camped some five or six miles further on.

Traces of a route along stream "J"

The stream we had just explored, is mentioned by Hayward as leading to an old, and even at that time a long disused pass across the Kara-koram to Nubra and Chorbut. Mir Izzat Oolah, an agent of Moorcroft, writing in 1812, also reports the existence of such a pass, and various travellers on the Indian side have been told by natives of a long disused pass in this neighbourhood. Before we started up this stream, I informed all the men with us, that it was believed to lead to a pass, and I offered a large reward to any one finding traces of previous travellers. Although one of the coolies found such traces on the 19th on our way up stream, he did not claim the reward, and I only heard of the discovery on the 23rd, after we had passed the place on the return journey. His story was, that about four or five miles above our camp at the junction, and on the bank of a small tributary, he had found a saddle-bag containing books, some clothes and a little tea, the latter of which he had taken. I returned and at the place indicated found the saddle-bag which still contained the books; several of these were copies of the Koran, in one of which were three opened letters written in Hindi. Nearby we found some metal cooking pots and the stock of a native gun. I had the letters translated and found they were dated some ten years ago (*i. e.* about 1904). When I reached Yârkand, I reported the discovery to the British representative there, who promised to try and find the writers of the letters who appeared to come from that neighbourhood, but no results were obtained. Although the condition of the articles when found makes it hard to understand that they could have been there as long as the date of the letters would appear to indicate, I have no doubt as to the perfect genuineness of the discovery.

It was very unfortunate that I did not hear of the find at the time, as when we decided to return I did not think that the stream could ever have been used as a route, owing to the difficulties of the passage. Consequently, with weather conditions so adverse, I had no inducements to proceed up stream beyond a place from which the sources could be mapped. I also, at that time, supposed that Dr. De Filippi's party was exploring the Oprang, which valley I felt sure was on the south side of the range at the head of the stream. Had I known of the discovery of traces of previous travellers or that Dr. De Filippi had been prevented from entering the Oprang, I should certainly, whatever the weather conditions were, have made an attempt to reach the range and seen the pass leading into the valley to the south.

Comparison between practicability of streams "I" & "J"

The relics that we found, point to the existence of a track up this stream, but, under present conditions, I cannot understand why it should have been selected in preference to the adjoining one "I". Both these streams rise from a range, which must be crossed before the valley between it and the Kara-koram is reached. Stream "I" is open and contains good grass and fuel, "J" is difficult and barren. It is of course possible that, at the time this short cut to Nubra was used, the large glacier, whose moraine now forms the gorge near the source of stream "I", was the obstacle to the use of this valley, but this could have been avoided by following the valley of the two lakes. But whatever was the reason, there is no doubt as to which is the better route at present. It is also quite certain that a route up stream "J", on account of the amount and depth of water in it, is only feasible from late in September to May or possibly early June. Whether passes across the northern and Kara-koram ranges are open much after 1st of October or before June is very problematical. We experienced heavy and practically continuous falls of snow from the middle of September at 15,000 feet and as no gap in the Kara-koram range here can be much less than 19,000 feet, any pass over it must be very difficult.

Surmise regarding the Oprang

I have come to the conclusion that the Oprang must rise much further west than the point where Sir F. Younghusband placed its source, and that the glacier resting on pass "G" whose western snout drains into valley "H" must be a source, and probably the head, of this river. The range, on the northern slopes of which

streams "I" and "J" rise, would in this case be the Aghil, and all the passes at the head of these streams should lead into the valley which I consider must be the Oprang.

Suggested plan for future exploration

This is important for the future exploration of the Oprang, for, if my supposition be correct, the easiest plan would be to enter it early in the year by the pass "G". Up to the present, the only entrance to the Oprang has been considered to be by the Aghil pass, entailing the crossing of the Yārkand river below Bāzār-dara. This passage is practically impossible, without boats, which would have to be transported there, before the end of October, owing to the great volume of water in the river. Exploration of the Oprang valley, *via* this route, would therefore have to be undertaken in the very late autumn and winter; if however my surmise is correct, the valley could be entered early in summer, and its survey carried out during the open season. On completion, the return journey to India could either be made by the same route, by the Aghil pass if late in the year, or by the Shingshāl pass to Hunza and Gilgit. There is also the possibility of finding the lost pass across the Kara-koram into the Nubra district, which has been mentioned earlier.

Continuation of journey to Khafelang

On the 24th September, the weather having improved slightly, Spranger and I climbed a hill on the right bank of the Yārkand river. There was a good deal of freshly fallen snow to negotiate, and the climb was laborious, but once the summit was reached the view was good, though none of the more distant snow peaks were visible owing to storms on the higher mountains. The wind had been rising ever since we left camp, and on the summit was blowing with great violence, driving the powdered snow from the ground, and making work with the theodolite a matter of great difficulty. Nevertheless, I succeeded in taking observations to most of the nearer peaks. We camped that night close to the site of our camp of the 9th September, and next morning Spranger and I ascended another hill, this time on the left bank. Fortunately the weather was fine, and although the distant ranges were still hidden by clouds, I was able to get third rays to most of the peaks in the neighbourhood. In the evening we halted at Khufelang, Shib Lal having joined us the previous day.

A day or so before this, we had heard that, owing to the great depth and volume of water in the Yārkand river, Dr. De Filippi had been unable to effect a crossing below Bāzār-dara, and had been compelled to abandon his proposed exploration of the Oprang valley. He had consequently gone on to Yārkand, sending most of his coolies to help me if required, but they heard, on reaching Khufelang, that we were marching down stream and remained at that place till we arrived.

Return of coolies to Ladākh

The exploration work of the expedition being finished, the coolies were now to return to their homes in Ladākh. As Jamna Prasad had been unable to survey in any detail the country between Ak-tāgh and Khufelang, when he marched between these places at the beginning of the month, I decided to utilize the services of the returning coolies and sent Shib Lal with them to fill in the gaps in the survey along this route.

Accordingly, he started on the 26th September, and having completed the work in two days, returned to Khufelang in one march on the 28th. The coolies sent by Dr. De Filippi and fourteen of my men, accompanied him as far as Ak-tāgh, from whence they returned *via* Leh to their homes. I hoped that the weather would improve and permit me, during Shib Lal's absence, to observe, from a high hill in the vicinity, to the distant ranges, but it remained as adverse as it had been since the 20th September—more or less heavy snow at night, with heavy clouds or snowstorms obscuring even the low hills by day. As I only required observations to the distant and higher ranges, it would have been a waste of time and energy attempting any triangulation under such conditions; Spranger and I therefore employed our leisure in computing the co-ordinates of such points as might prove useful for the survey of the river to Kirghiz-jangal.

Route traverse to Kirghiz-jangal

On the night of the 28th September we had the heaviest snow-fall yet experienced, and snow was still falling when we left our tents at 6 a. m. desirous of making an early start in order to reach Kirghiz-jangal in two marches. The cold seemed entirely to sap the energies of the Kirghiz, and much time was wasted in loading the ponies; our departure, far from being early, was much belated. The ponies notwithstanding three days' rest at Khufelang, were very weak from the hardships they had undergone, and progress was slow. Fortunately the river had greatly decreased in volume, since I had come up three weeks earlier, and could now be forded anywhere without much difficulty.

Latitude control

We only managed to march about fifteen miles that day, and seeing our chance of reaching Kirghiz-jangal in two days was doomed to disappointment, I tried to make a station en route, but the weather remained unfavourable. Accordingly whenever the weather permitted, I observed stars for time and latitude. The results of these observations afford a sufficient check on Shib Lal's traverse of the route, which owing to the length of the marches, the shortness of the days, and the confined nature of the valley, was all that he could execute.

On the 1st October we reached Kirghiz-jangal, halting three or four miles below my old camp at the junction of the Suget road (*via* the Kök-yárt-dawán) with the Yárkand river. Here fresh transport should have met us, but it had not arrived. I tried to persuade our men to take their ponies at least one march further, but they absolutely refused; we were therefore forced to halt until the new transport arrived.

On this day the weather took a welcome turn for the better, and on the 2nd this improvement continued. I employed the time by climbing a hill above our camp and making a station there. This hill was not high enough for me to see the more distant southern ranges, but I recognised several of the peaks previously fixed, and from them was able to resect the position of my station, and fix that of the camp below. On my return, I found an advance guard of the new transport, and the man in charge gave me the welcome information that the remaining ponies would arrive during the night.

We were therefore able to resume our march down the river on the 3rd October. The river valley now opened out, and occasional glimpses of snow peaks were obtained from the route. That night we camped on the left bank of the Yárkand river, almost opposite the junction of the stream flowing from the Yangi pass. Downstream from this camp, a curiously shaped hill, not high but rather like a camel's hump, forms a conspicuous object in the landscape. The main river flows to the west of it, while on its east side is the Yangi pass stream.

During the last few days, the weather had been improving, and I had high hopes that the day we crossed the pass would be fine. Hayward states that, from a hill near the pass, he obtained a most extensive view of the Kara-koram range, and I was looking forward to making a final station here. Owing to the continual bad weather experienced during September, I had been unable to get second rays to many of the higher peaks, and this would be the last opportunity of definitely fixing them.

The Yangi-dawán

I therefore started very early on the 4th October. The sky was clear when I left camp, but very soon heavy clouds began to form and my hopes of a good view were speedily put to flight. Long before the summit was reached the whole sky was overcast and when I arrived at the pass, heavy snowstorms hung about the comparatively low peaks, visible from the pass itself. It was useless climbing higher, for it was only too evident no distant view could be obtained. This was regrettable, as a large number of useful observations were wasted, and many of the peaks at the head of the two streams "I" and "J", which we had been exploring, remained unfixed.

I was even unable to obtain a latitude from observations taken on the pass, the sun being obscured at midday, and though it was visible for a few minutes just afterwards, I could not take circum-meridional observations, as my two watches had met with accidents, and Spranger did not arrive till too late.

The road to the pass follows the bed of the stream the whole way, from the main river. At first the valley is rather restricted, with a moderate gradient and

fair track. About four miles from the river, the valley contracts more, and for the next three miles or so forms a narrow gorge. Here, naturally, the slope is greater and the surface very rough. Beyond the gorge the valley opens out and is wider than at any other part. The bed is almost flat for some distance and the stream is joined by many tributaries. A mile or so below the crest of the range, another stream, carrying practically the same amount of water, joins almost at right angles, the road keeping to the western branch. The valley had been absolutely bare of vegetation up to this point, but here a little grass and '*būrtsi*' is found, and in two places the remains of camp fires were noticed. This, presumably, as Hayward remarks in his itinerary, is the usual camping ground, but his description of the route was based on native reports and he did not cross the pass himself. The place gave me the impression that it was used more as a resting place to cook a meal, than a regular camping ground. From here the road follows the open valley, gradually getting steeper, but the surface remains good and nowhere is the ascent very arduous. The pass is not much lower than the greater part of the range in the vicinity.

The rock formation at the crest is limestone; on the way up more or less laminated shales predominate, but along the entire *nālā* I did not see a single piece of granite. This is surprising as the boulders in most of the *nālās* joining the Yārkand river on this—the right—bank below Kirghiz-jangal, were practically all of a pretty, red and green, mottled granite. The crests of the K'un-lun range, when visible from the river, have all the appearance of limestone, and as this is the formation at the pass, it is likely this rock persists along the edge for some distance. I searched for over an hour among the rocks to the east of the pass for fossils, but found none.

The pass is about 10 or 11 miles distant from our camp in the river, but the ponies, having strayed in the night, did not reach it till 3 o'clock. We thus did not reach our intended camping ground, and had to halt just before dark a short distance north of the pass, at the junction of the stream leading from it with the main stream, which rises further west. The descent, as far as this junction, is somewhat steep, but the surface is good.

Next day, the 5th October, we continued our march downstream. The limestone, so noticeable on the crest, soon ceased. Below our camp granite boulders were noticed in the stream-bed, and two or three miles lower the formation was granite. The valley is fairly open, but at places the actual water-channel is rather confined. In such places the road surface is rough, but on the whole the pass cannot be called difficult at this time of year.

Tūr-aghil

About five or six miles below our camp, a large open valley joins from the right bank and at the junction is a small mud and stone hut, said to be a fort. This valley is known as Tūr-aghil, and contains much grass. At its head is a fine rock and snow ridge, visible from the main stream.

After passing Tūr-aghil, the prospect becomes more open, the hills on the left bank, to which side the road keeps, approach the stream in more or less rolling plateaux. On the right, for three or four miles, precipitous walls of almost black rock rise abruptly, skirted by the stream, now of some volume. Flowering plants make their appearance, and the whole valley looks more habitable than any seen by us hitherto north of the Kara-koram. We camped, after a short march of about ten miles, at a large patch of grass, for which I could obtain no name.

Kuija-mazār

After travelling down stream about sixteen miles, next day we arrived at Kuija-mazār, where we met cultivation for the first time since leaving Shyok, nearly five months previously. The general appearance of the valley was open as on the preceding day, but at times it closed in. Granite and schists alternate, while deep conglomerate beds, cut through by the stream, frequently occur. Vegetation becomes more profuse, and trees, solitary at first, are frequently met.

Kuija-mazār, where the road over the Chirāgh-sāldi pass joins our route, consists of a few houses dotted about the valley, and has a comparatively large area of cultivation. A *pir's* grave, close to which is a large burying ground, gives its name to the place.

The march on the following day, the 7th October, was about the same distance, but the going was rougher. The valley is

more confined and the crossings of the boulder-strewn stream frequent. About ten miles below Kuija-mazár, the stream cuts its way through a most remarkable narrow granite gorge. Its walls, about 100 feet apart, rise practically perpendicularly for an estimated height of 600 feet, and as far as the summit have all the characteristic features of water-worn rock. The effect is most bizarre and striking.

Camp was pitched at a picturesque spot in the valley, just below the junction of our stream with a narrow *nálá* on the left bank, which latter is followed by the road from Bázár-dara *via* the Ishak-árt pass. A mile or so above our camp a large stream, carrying about the same amount of water as the one that we had come down, joins from the right. I was told that this stream, the Ulúgh-kailak, flowed from a pass, known as the Ulúgh-kailak-dawán, half a day's march distant, leading to the Toghra-su *nálá*, and thence to Shahídulla and Suget. Further questioning elicited the information that the pass led from the Ulúgh-kailak *nálá* direct to the Toghra-su, and that the Kartik-dawán was some distance from the Ulúgh-kailak-dawán, but the routes over both passes join lower down. If this is correct, the Toghra-su (Tou-ru-su of the French 1/M map) must extend a good deal further west than is shown on the present maps.

This stream is presumably the Oglok of Hayward, but only one large stream joins on the right bank and not two as stated by him. The Kirghiz with us did not recognize the name of the second stream, which Hayward calls "Sanoch" but on the following day a man from Yárkand recognised it, and from his description, I imagine it must be another name (possibly a Yárkand one) for the stream known to the Kirghiz as Ulúgh-kailak. Nor could I obtain any information about the name Cheklik given by Hayward to the camp between the junction of the Ishak-árt stream and that leading to the Ak-koram-dawán. The only names that I could hear of were Ishak-árt-aghzi for the place we camped at, and Ak-koram-aghzi for the spot opposite to the entrance of the stream leading to the pass of that name. Hayward's information, I should add, was obtained from native sources as he did not travel by this road himself.

At this camp (7th October) we joined the route followed by Dr. De Filippi's party, and as Jamna Prasad had carried the survey from here to Karghalik, Shib Lal closed his work. Owing to the necessity of our reaching Káshgar quickly, so as not to delay the other party, we had been compelled to make long marches, without any halts. In the narrow and deep valleys, through which our route lay, the only method of survey possible under these circumstances was to maintain a plane-table traverse. To have surveyed the surrounding country, we would have had to climb the ridges and that, in addition to a long march, was an impossibility.

Nature of survey work from Khufelang

From Khufelang to Ishak-árt-aghzi therefore only a traverse of the route was executed, with the survey of only such part of the neighbouring country, as could be sketched from the road. The portion of this work in the Yárkand valley is controlled by triangulation and the astronomical observations for latitude made at various camps. Beyond this, except at the camp just north of the Yangi-dawán, entirely overcast skies prevented all star observations until Ak-masjid was reached; therefore from the Yangi-dawán Shib Lal's survey has been adjusted on to Jamna Prasad's position of Ishak-árt-aghzi. This latter's work is controlled by the observations made by Abetti at Bázár-dara and Karghalik and by the latitude determinations made by me at Ak-masjid, Kök-yár and Bésh-terek.

Next day, the 8th October, we followed the stream, now some twenty yards in width and two feet deep, for about two miles, and then turned up a side *nálá* joining on the right bank. This, after a short distance, enters a narrow gorge of white marble, from which the pass takes its name (Ak-koram = white rock in Turki). The road in the gorge is very rough, steep and difficult for animals. Beyond, the valley opens out, and the track to the pass is easy, except for the last 500 feet which is very steep, although the surface remains good. North of the pass, the conditions are much the same, but gradually the valley opens out and at length Ak-masjid, a place of one or two houses, is reached and here we camped.

From Ak-masjid, which appears to be the name for the neighbourhood as well as the hamlet, the road continues down the centre of an open grassy valley, until it

bends westward. Here it drops sharply through a narrowish gorge, to the undulating plains below.

After leaving Pasha, the first of the villages of the plains, the stream keeps to the cliffs at the foot of a low ridge, and is fringed on the east by cultivation. Four or five miles below Pasha, the large valley of Kök-yâr is reached, where we camped.

Next day, a large sandy tract of low undulating country, sparsely covered with a weed-like vegetation, is crossed, after which the road passes through a gap in a group of low ridges. At the foot of these, a cluster of small hamlets known collectively as Bêsh-terek forms an oasis of cultivation in an otherwise barren desert, and is the half way halting place between Kök-yâr and Karghalik.

From here we reached Karghalik on the afternoon of the 12th October. A few miles before reaching the town extensive cultivation is met, and the tree covered plain was a welcome change from the bare and bleak mountains, in which we had been travelling so long.

Arrival at Karghalik

As Karghalik is on the main caravan route from Leh to Yârkand, and has been often described, no further description need be given here.

We reached Yârkand on the 13th October, and here heard for the first time that England was involved in the European war. Halting at this place for one day, we arrived at Kâshgar on the 19th and there rejoined Dr. De Filippi and his two companions.

Yârkand

VIII. THE JOURNEY TO EUROPE.

On the 27th October, after the completion of the gravimetrical and astronomical observations, we left for Andijân, the nearest point on the Russian railway system. It was not considered advisable, owing to the unsettled state of the countries through which we would have to pass, to take Jamna Prasad and Shib Lal with us, so they spent the winter in Kâshgar, and returned to India in the following spring when the passes were again open.

We reached Irkishtam, the Russian frontier post, on the 31st and after a difficult passage of the Terek-dawân, which was covered with much freshly fallen snow, arrived at Andijân very late in the evening of the 6th November. Leaving this place on the 8th, we arrived at Tâshkent the following day, where we remained till the 19th November.

Arrival at Andijân

During our halt here, gravimetric observations were made at the Russian observatory by Abetti, while Spranger and I were fully occupied in computing, making traces of the survey, and copying the angle books of the triangulation.

Owing to the war, part of the heavy equipment was left at Kâshgar, to be taken to India by Jamna Prasad while the remainder was left at Tâshkent, where I also left copies of the maps and angle books.

Between the 20th and 24th November, we paid a flying visit to Samârcand and Bokhâra, and finally left Tâshkent on the 27th of that month.

No express trains were running in Russia, and it was not till the 6th December that we reached Odessa. Our baggage did not arrive there till the 10th and we were unable to leave till two days later. Crossing the Russo-Roumanian frontier the same day, we reached Bucharest next morning, where we were most hospitably entertained by the Roumanian Government and the Italian colony.

Bucharest

A broken bridge prevented us from taking anything but the lightest of hand baggage to Salonika, so from Bucharest, the Italian members of the party—Italy being at that time a neutral—travelled *via* Buda Pest, with all the baggage; Spranger and I after a very tiring but interesting journey, arrived at Salonika on the 19th December. Proceeding thence *via* Athens and Brindisi, I reached Rome on Christmas day. Here I remained till 27th January 1915, preparing a provisional map of our surveys, and completing as far as possible, the computation of the triangulation.

Via Athens and Brindisi to England

The result of the survey work of the expedition is the mapping of about 5,000

sq. miles of country, that was previously entirely unknown, or of which only the roughest of sketch maps were available. The survey of this area is controlled by a net-work of triangulation composed of 50 stations and about 200 peaks fixed from them.

Survey work accomplished

In conclusion, I must place on record the exceptionally good work done by Sub-Assistant Superintendent Jamna Prasad and Surveyor Shib Lal. The conditions, under which their work was performed, were always very arduous, and often dangerous; but throughout the entire period they never allowed their zeal to slacken, and they carried out their duties to the admiration of every member of the expedition. Often belated at night, to spend it in snow storms without shelter, fire or food at very high elevations, they were always ready on reaching camp next morning, to start again with undiminished energy, and they never allowed any thoughts for their own personal comfort or health to interfere in the execution of their work. I cannot speak too highly of their services.

Conclusion

I also desire to offer my grateful thanks to Dr. De Filippi, the leader of the expedition and to Mr. A. J. Spranger, who accompanied me throughout.

To Dr. De Filippi's wonderful genius for organization, the successful termination of the work is due. No one, unless he has actually travelled in a country, where every essential for human and animal existence is lacking, can realize the amount of careful and constant thought and foresight necessary to equip and organize an expedition of the magnitude of the one, of which I had the good fortune to be a member. The whole supply and transport *bandobast*, the burden of which fell on Dr. De Filippi, worked without the smallest hitch, and the specialists of the party were thus free to devote their whole energies to the prosecution of their work without anxiety or trouble.

Mr. Spranger's assistance lightened my work very considerably and enabled a much greater amount of triangulation to be executed than if I had been alone.

Last, and by no means least important, I would like to add a word of praise for the Ladākhi and Balti coolies, whose labours enabled us to penetrate into places, where, without their valuable aid, we could not have ventured, and whose cheerful bearing, under great hardship and discomfort, it is impossible to overrate.

POST-SCRIPT.

Subsequent to this report being sent to press, I had, during a recent visit to Calcutta, an opportunity of inspecting the original plane-table sections of Mr. Johnson on which Atlas sheet No. 44 A (SE.) was based.

When I referred in the report to the topography of this country as shown on the Atlas sheet, I was under the impression that Mr. Johnson had made the survey on his return journey from Ilchi in 1865, and during a brief winter visit, had sketched in the Remo region from the neighbourhood of the Kara-koram pass. [1] While using this sheet on the ground, it was noticeable that though the highest mountain ridges were more or less recognizable, the valley areas were very incorrectly depicted. This is what one would rather naturally expect, on the assumption that the ground had been sketched from a distance; more particularly in country such as the area under discussion, where the run of the valleys is complicated and confusing. But an examination of the originals shows that the Atlas sheet to the west of the Saichar (Siachen) glacier was derived, not from Mr. Johnson's winter sketches of 1865, but from a more regular survey during the summer of 1864. This work is shown on two plane-table sections, of which only one has been used for the Atlas sheet, and on this one the area surveyed is practically coincident with that shown on the map under reference. The second is headed "Rough sketch of a portion of the country North of the Kara-koram pass". It is admittedly a sketch and I can not find that it has ever been utilized, except possibly for the smaller scale maps and no further reference need be made to it, except to say that it is nothing like the country and seems to be purely imaginary.

The first or southern section appears to be a regular geographical survey or detailed reconnaissance on the scale of 4 miles = 1 inch, as on it the plane-table fixings are marked by small red circles. In the area between the Kara-koram pass and the Remo glacier 14 of these are shown, usually on the highest peaks. These fixings are well distributed and as each position must have been visited, should indicate at any rate that a considerable area was actually traversed; and though the number are too few for an accurate survey on the scale adopted, the main features should certainly have been correctly deliniated. This however is very far from the case and, to me, it is absolutely inconceivable how any trained surveyor, visiting the points marked on Johnson's original, could have produced a map so unlike the ground as he did.

Since Mr. Johnson's visit to this neighbourhood and previous to that of the 1914 expedition, only one additional peak (Pk. 50/52 E) has been fixed by the Survey of India; but from the points marked by him as plane-table stations quite sufficient fixed points are visible from which accurate resections can be obtained. Several of the points so marked are those either on which I made stations, or in the close vicinity of them. The views from these are entirely unlike that represented on the Atlas sheet, which is quite a faithful representation of Johnson's original plane-table section.

I will only refer in detail to six of these fixings, from where it would appear that the valleys occupied by the Remo glacier had been surveyed; as it is in this neighbourhood that the topography is more inaccurate than in the more open country to the east near the trade route.

I give below the co-ordinates of these points with reference to the Atlas sheet, and also those of the same points, or what I imagine them to be, with reference to the map accompanying this report. It should be noted that the Atlas sheet longitudes require a correction of —3′ 36″ to bring them into relation with the longitude of this modern map.

[1] The Geographical Journal Vol. XXXV. 1910. p. 654.

Reference Number.	Co-ordinates of p. t. fixings.					Remarks.
	On Atlas sheet.		On map accompanying this report.			
	A.	L.	A.	L.	H.	
					feet	
1	35° 15′	77° 53′	35° 10′	77° 50′	22,750	
2	35 16½	77 37	35 17	77 32½	21,407	Identification doubtful.
3	35 20	77 47½	35 22	77 41	...	On ridge between ·20130 and ·19120.
4	35 21	77 37¾	35 22	77 33¾	19,472	
5	35 26½	77 42	35 29½	77 33½	20,912	
6	35 34¾	77 35½	35 36¾	77 26	21,410	Identification very doubtful.

No. 1 is on the highest point of a prominent snow covered mountain. This is easily identifiable on the panorama made by Schlagenweit from the Depsang plateau and called by him "the Depsang Peak"; though his identification of it as a peak fixed by the Survey of India, judging by the co-ordinates and height given on his panorama, is hopelessly wrong. This mountain is a very difficult one to approach and I very much doubt if it could be climbed by a single person; nor can I imagine why any one should attempt to reach its summit for survey purposes. But the view from the top is directly up the valley now occupied by the main Remo glacier. This valley Johnson shows from 10° to 15° wrong in azimuth, which is an impossible error for a surveyor, as from the summit, a perfect fixation from known points must easily be obtainable.

Nos. 2 and 4 are on the southern and northern ridges of the western Remo glacier. Johnson shows these points as 3½ miles apart, but the watershed ridges of the valley on which he marks his stations are separated by almost, if not quite, double this distance. Furthermore, this valley is practically of the same width throughout, but Johnson makes it fan shaped, with a width at its head of 16 miles, or five times that of it opposite his southern station, from where the whole upper reaches of the valley lie open. The very high and prominent peak at its head (Pk. 50/52 E) is not marked in any way and the 3 long glaciers occupying the north-west portion of the valley are absolutely imaginary, or if they are intended for the small subsidiary glaciers into which the main one splits close to its source, they are enormously magnified and out of position.

Nos. 3 and 5 are points close to where I made triangulation stations. No. 5 is very much out of its true position and from both these the error in the direction of the main valley, mentioned when discussing point No. 1, is inexplicable. The views from both my stations are described on pages 5 and 6, and 9 of this report, and as point 5 is on a higher peak than my station was, the view from it should have been more extensive. From this point also the error in the direction of the valley to the north (that of the Yārkand river) is most noticeable. He shows it as running almost due north for about 6 miles where it makes an abrupt bend almost due east, whereas the true direction is north-east throughout.

No. 6 is almost impossible to identify exactly, but I have given the co-ordinates of what seems the most probable position. But absolute identification is immaterial; the salient point is, that it is shown to the north of the Yārkand river. To reach this point from any direction, the river must be crossed at some place, even if the valley itself had not to be traversed for some distance. Not only is the valley very much out in azimuth as mentioned above, but the river is shown as flowing in the exact reverse direction to reality. This error—when it is realized that the survey was made, not in the winter when the stream would be frozen and snow covered, but in summer, when the snow line is some thousands of feet above the valley bottom and there is a big flow of water—is absolutely inexplicable, if the fact is to be accepted

that Johnson made his survey from the positions marked on his original.

I have only drawn attention to the most outstanding errors and omissions, which not even an untrained person constructing the crudest of eye sketches from these points should have made. It is no question of small and comparatively unimportant details, but that of the whole area being so inaccurate, that it is hardly possible to decide with any certainty which any main feature is. Nor have I taken into consideration the remarkable absence in Johnson's map of the immense glaciers which now fill these valleys. We know from Shaw's sketch[2] that in 1869 the Remo snout was very much in the same position as it is now. Glaciers have been known to advance in a period of 5 years—the interval that elapsed between Johnson's and Shaw's visits—as far or further than would be necessary to reconcile the discrepancy in the size as depicted by Johnson and as exists now, which as stated above can be assumed to be similar to that of 1869; but no glacier advance can alter the entire topography of the region or explain the presence of large ridges, which are now after a presumed glacier advance, at a close distance to, and in full view from Johnson's stations, and which are not shown on his map.

One is naturally opposed to throwing discredit on the work of a previous explorer, particularly when that explorer is in the same service as oneself, and most especially when he is no longer able to reply. But Johnson's work has been for years a matter of controversy, and in such cases the truth even if unpleasant, is necessary. I have gone into some detail on these points so that any one interested can compare the two maps and form his own conclusion.

Before writing this note, I consulted the Surveyor General on the expediency of publishing the conclusions that I had come to after my examination of Johnson's original surveys. He has seen all the material and some photographs[3] taken from points, either exactly at, or very close to, three of the points marked by Mr. Johnson as his plane-table fixings, and has come to the same conclusions as myself and decided that this note should be published in the interest of historical accuracy.

Mussoorie
April 1922.

H. W.

[2] Vide page 6 of this report.

[3] These photographs are prints from negatives taken by Lieut. Antilli, the photographer of the expedition. I have no doubt that reproductions will be published in Sir F. De. Filippi's report.

APPENDIX.

NOTES REGARDING DISUSED ROUTES OF THE KARA-KORAM.

Mention has been made in this report of a long disused and now forgotten pass across the Kara-koram range. The early explorers of this region summarize the route from native information, but there is no record of any European actually travelling by it. As the literature on the subject is scattered and difficult to find, an attempt has been made in this appendix to collect in one narrative what material is available.

General character of Kara-koram

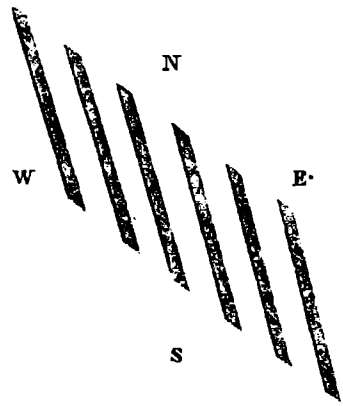
The Kara-koram range, which contains some of the highest mountain peaks in the world, lies athwart the direct path between the plains of Northern India and the cities of Central Asia, and forms an exceedingly difficult barrier to all intercourse between them. Our knowledge of the topography of the range is not great, and the mountain mass is so involved and intricate that any general description of it is by no means easy. I feel I cannot do better than give the following extract, which though written about the mountains which lie considerably to the east of those under review, applies with equal force to that region.

H. Strachey's generalisations

"The mountains that compose the bulk of West Nari are not easily understood or defined. On ascending the highest passes, we can seldom see anything but a contracted view of mountain tops on all sides, looking very like chaos: no general view of the range under our feet is ever obtainable, as the passes naturally select the ravine heads and lowest points of the ridge, which are not only flanked, but often almost surrounded by the higher summits; and the valleys are commonly so steep and narrow, especially in the Rong country, that the view can hardly ever penetrate to an alluvial bottom, and the sight of any inhabited place from a pass top is most unusual. When travelling along the bottoms of the valleys, we generally see nothing but a narrow tortuous passage, between steep rocky walls, shutting out all extended view, and rather concealing than exhibiting the mountain ranges of which they form but the mere lowest out-works: consequently it is only by an extended series of observations and inferences, joined and assisted by maps, that any regular arrangement of these mountains can be distinctly established; and my account of them is liable to error in proportion to the defects of my own map.

"The general plan of the mountain system appears to consist of a series of parallel ranges running right across the breadth of the tableland in a direction so extremely oblique to the general extension of the whole as often to confound the one with the other, or to convert

the transverse direction to a longitudinal one. The annexed figure may help to explain this. Short transverse necks connecting the main ranges in some parts, and cross fissures cutting through them in others, together with projecting spurs of a secondary order, will suffice to convert the supposed primary arrangement into all the existing varieties, of valley and drainage. Such connecting necks, when above 18,000 feet, become more or less confounded with the main ranges, and if not above 17,000 feet, often appear as low watersheds, just dividing the heads of two valleys lying in one line but draining opposite ways. Secondary spurs also may be so high and so obliquely joined to the primary ranges as to make it difficult to distinguish between the two; and the cross fissures may sometimes admit a main river to pass through a main mountain mass, in which case the continuity of the range is often evidenced by the extreme narrowness of the rocky gorge, or height, steepness and geological correspondence of its sides.



"Much of the Indian watershed seems to be formed in this way; the great snowy peaks lying mostly on the terminal butt-ends of the primary ranges, sometimes widened by lateral spurs; and the Tibetan passes crossing the low connecting links, whose alignment forms the main watershed, but not the main mountain crest. From what little I know of the Turkish watershed, I should suppose the same formation to exist there also." [1]

Reasons for divergence from Kara-koram pass route

It is undoubted that for nearly 2,000 years, such traffic as has existed between Central Asia and India has followed the present track, crossing the Kara-koram range by the pass which has given its name to the mountain mass; nevertheless at times when this route has been impracticable—either owing to squabbles between the local rulers, or for other reasons—travellers have been forced to search for other paths across the mountains; and on such occasions, since the Kara-koram pass route involves a considerable detour eastwards, it is natural that more direct alignments to the west of it were looked for, although they involved much glacier travel. These temporary paths, owing to their own inherent difficulties were abandoned as soon as the main route was again available. But though abandoned, memories of them lingered amongst the inhabitants of the highland valleys, and no doubt stories about them were passed on from one generation to another and were related to the early European travellers. Even to this day rumours persist and it is possible that these tracks are still occasionally used by the bolder villagers, when a quick passage across the mountains is essential.

Muz-tāgh pass

Excepting the Kara-koram pass, the one that appears to have been most in use is the Muz-tāgh pass, situated at the head of a branch glacier of the Baltoro. It was in more or less constant use until the early years of the last century, when changes in the condition of the glaciers forced it into desuetude shortly before European exploration of this region began. Colonel Sir F. Younghusband is the only known European to have actually crossed it, though others have approached it from the Indian side. A full account of the passage appears in Sir F. Younghusband's book [2] and need not be further mentioned here.

[1] The physical geography of Western Tibet.—H. Strachey. 1854.

[2] The Heart of a Continent.—F. Younghusband.

To the east of the Muz-tāgh pass lie the highest portions of the Kara-koram range culminating in the K. 2 massif, but between this group and the Kara-koram pass, native rumour assigns an old route; it is with the literature of this passage that the remainder of this note deals.

Old route between Muz-tāgh & Kara-koram passes

The first reference that I can trace dates back as far as 1543. In that year Prince Mirza Haidar, the ruler of Kashmīr, appears to have been sufficiently interested in geography to compile a book on the subject. From an article [3] on this book by R. Shaw I have extracted the following description of the road from Yārkand to Kashmīr. "As the chief acclivity in the ascent from Yārkand is the acclivity of Sanju so the chief declivity in descending towards Kashmir is that of Iskardo. From this acclivity to that is about 20 days journey".

Mirza Haidar, 1543

This may of course refer to the Muz-tāgh pass route; it certainly does not indicate that by the Kara-koram pass, for on his return journey he writes—

"We arrived at a place called Karakorum at sunset. There is a large stream; it was all frozen . . . . . Through such hardship we reached the place (Taghatak) where the unknown road to Badakshan separates off".

Mir Izzet Oolah—an agent of Moorcroft—writing in 1812, is the next to mention it. A translation of his diary appears in the Calcutta Quarterly Oriental Magazine for 1825 Vol. III. To this I have not been able to refer, but a reprint with corrections is given in the journal of the Royal Asiatic Society of Great Britain Vol. VII. 1842-43, from which I give an extract of the relevant parts dealing with his travels from Leh to Yārkand.

Mir Izzet Oolah 1812.

"*Khamdán.* On our left hand between the south and west is a mountain of ice, which remains unmelted throughout the year. They say it is 200 cos in extent, and on one side is Tibet Balti, and on the other Serkul, on the boundaries of Badakhshan. From Kashmir to Yarkand, by Balti, is a journey of twenty-five days, three of which are over this glacier, and it is therefore rarely travelled. There is said to be a shorter road, avoiding the icy mountain but the people of Tibet keep it a secret.

* * * * * * *

"*Khafalun.* Six hours' march from Akták was a station with wood and water called Shah-i-ab, after leaving this a road was observed upon our right or to the north, leading over the mountains, by which in the summer time, when the waters are out, travellers proceed to a place called Kalian in Kokiar, a dependency of Yarkand. From the vicinity of this place there was a short road to Tibet Balti, by which in former times the Kalmaks and Kirghizes penetrated into that country. It is said that in order to stop these incursions, water was conducted into the defiles by some contrivance, and this being frozen, completely blocked up the passages.

* * * * * * *

"*Bagh-i-Haji Mohammed.* On the road half way is a place called Kirghiz thicket,... . After passing Kirghiz Jangal, we came to a pass on our left, which leads to Srikul, on the confines of Badakshan."

I have also seen a monograph entitled "Travels in Central Asia by Meer Izzet Oolah in the years 1812-13. Translated by Captain Henderson attached to the Foreign Office of the Government of India 1872. A Persian manuscript placed at the disposal of the Foreign Office by Nawab Zeea-ood-deen of Loharoo." This translation, though more literal, gives the same information as above.

This journal is very interesting as Mir Izzet seems to have been the first traveller along this route, in what may be called modern times, to leave behind any record of what he saw. His descriptions and statements, where they can be checked in the light of modern knowledge are wonderfully accurate, and the information he records, though not embodied in the maps of the time, is correct and the old maps are wrong. A very good example of this is shown in his account of the Yārkand river. The route mentioned as leading from near Kirghiz-jangal to Ser-i-kul is, so far as I can discover, not mentioned by any other traveller; if it exists it is possibly an easier route to the Pāmīrs from the Yārkand river than that now in use. Below Kirghiz-jangal the

His accuracy.

[3] A Prince of Kashgar on the Geography of Eastern Tibet.—R. Shaw. Journal of R. G. S. Vol. 46. 1876.

passage of the river valley is very difficult, while the Oprang valley, into which any pass from the Yārkand river must lead, may be much better.

From the similarity of the wording, all other travellers who have written about this neighbourhood seem to have drawn largely on Mir Izzet's narrative and unless further information is given I have not referred to them in this note.

Gardner's journey 1829-30

In the Journal of the Asiatic Society Vol. 22, 1853 is an article entitled "Abstract of a journal kept by Mr. Gardner from Herat to Yarkund and thence to Kashmir—Journal lent to Sir A. Burnes in Cabul and only part recovered." This journey took place in 1829-30 and a diary from September 27th, the day the traveller left Yarkand—to November 13th when he reached Srinagar, is given. The name of each halting place is stated, but the majority are untraceable. It seems probable that the route was by the Yangi and Kara-koram passes and is only mentioned here, as it might conceivably be some other one.

G. T. Vigne, 1838

The next information we get is from the Indian side. Mr. Vigne in September 1838 was at Shigar, from whence he hoped to proceed to Turkistān. Finding it too late in the year to cross the Muz-tāgh pass he writes:—[4] "I then enquired about the other way, which I understood to descend, after crossing a glacier, upon the northern end of the valley of Nubra; and one morning, some men whom Ahmed Shah had sent to explore, returned with most weather-beaten faces, and said, that the snow and ice on the pass, which had been shut for many years, had now increased to such an extent as to render its practicability rather doubtful. By this way, if I could not reach Kukán,[5] I could at all events arrive at the Nubra Tsuh.[6]

Vigne's 'Ali-bransa'

He made an attempt to reach the pass, but after ascending the glacier for about six miles from its front, he was forced by bad weather to return. He gives no name to the pass but on the map accompanying his book he calls it the Ali-bransa pass. He states that from the furthest point on the glacier which he reached, the route continued on ice for 3 or 4 days' journey, and that two lofty passes had to be crossed on the way. He does not definitely say whether these two were additional to the one at the end of the glacier which he ascended, but the context does not forbid this interpretation. After his return to Shigar, he ascended a second valley as far as the village of Kor Chondus, and on the map the Alibransa pass is shown at the head of this nala.

Vigne's critics

The authors of "Two summers in the Ice Wilds of Eastern Karakorams" make grave reflections on the statements of Vigne, basing their arguments on the map, in spite of the text stating quite clearly that he sought for a pass at the head of the glacier now known as the Bilaphond, though the map inadvertently shows the pass at the head of the second valley that he explored instead of the first.

Dr. Thomson, 1847-48

Vigne is followed by Dr. Thomson, the first European to reach the Kara-koram pass, who describing his travels in 1847-48 says[7],— "The second pass is that marked in Vigne's map as the Alibransa pass, at the head of a considerable tributary which joins the Shayuk river opposite Khapalu. The enormous glacier over which this road runs, by which, in conjunction with the lateness of the season, Mr. Vigne's attempts to cross the pass were frustrated, has been well described by that traveller. I did not, while in Tibet, meet with any one who had crossed it, and I was assured by the inhabitants of Nubra that they were not acquainted with any road from the upper part of their valley, either towards Khapalu or towards Yarkand".

Very little weight can be given to negative evidence of this kind, as it is well known that natives of India will deny all knowledge of routes perfectly well known to them, if they have the slightest suspicion that they may be called upon to act as guides. This trait was apparently known to Dr. Thomson for in another place in his book he writes,—"Every one of

[4] Travels in Kashmir, Ladakh & Iskardu—G.T. Vigne 1842.

[5] An alternative name for the province of Andijan or Ferghana.

[6] The lake he supposed to be the source of the Shyok river.

[7] Western Himalaya and Tibet—T. Thomson 1842.

my guides positively denied the existence of any road in that direction; afraid, perhaps, that I might attempt to proceed by it; for I learned afterwards, on my return to Le, from a merchant of Yarkand, that there was an unfrequented path by which Khoten might be reached, if the Chinese authorities were willing to permit it to be used."

G. W. Hayward 1868

The next record comes from the northern side. Hayward who explored the headwaters of the Yārkand river in 1868, describing his march up to that stream, says :—[8] "On the evening of our 2nd day's journey from Kufelong we encamped in a wide part of the valley, opposite to the entrance of a deep narrow ravine effecting a junction from the south-west. At the head of this ravine a pass leads across the Karakoram range into the Nubra valley in Ladak, and to Chorbut, in Baltistan. It is apparently at a very high elevation, probably not less than 19,000 feet above the sea, and is closed for 9 months in the year by snow. It is impracticable for anything but foot travellers, and perhaps for yaks; and although not in use for many years, was formerly traversed by the Baltis, carrying their own loads of merchandise into Yārkand. This pass appears also to have been used by the Kalmāk Tartars in their successful invasions of Ladak and Tibet towards the close of the seventeenth century. From this point to the summit of the pass the distance is from 25 to 30 miles, the road ascending gradually up the ravine, flanked by the snow-capped spurs of the Karakorams".

In his itinerary of routes he further says :—

He reports two disused passes

"Two routes, not now in use, one from the head of the Nubra valley, in Ladak, and the other from Chorbut, in Baltistan, conduct down the main valley of the Yarkand river and join at Kufelong." The ravine here referred to is the "J" valley of the De Filippi exploring party and as stated in this report was followed almost to its source. Though relics of a previous traveller were found in one place, no information as to route itself could be extracted from anyone questioned. The ravine does not rise from the Kara-koram but has its source on a more northern range (probably the Aghil) which must be crossed as well as the intervening valley—the Oprang—before the main Kara-koram range is reached.

T.E. Gordon of the 2nd Yārkand mission

The Forsyth mission to Yārkand in 1873 adds very little to our knowledge of this neighbourhood. Trotter refers to the pass but from the similarity of the wording it is almost certain he is merely quoting from Hayward's narrative and he adds nothing new; but Gordon is rather more explicit. He refers to this route in describing the Sassir pass where he says :—[9]

"The state of the numerous huge glaciers clinging to the sides of the overhanging mountains, and presenting the appearance of being merely temporarily checked in their downward course, points to the probability of this pass being choked up at no very distant date, and obstructed for traffic, similarly as that which leads from near the head of the Kufelong source of the Yarkand river into the Nubra valley is said to have been. This latter was in ancient times on the main route by which the hosts of mounted invaders crossed into Little Tibet, but now it is only passable on foot. At present, the only travellers by it, are the hardy inhabitants of Baltistan, to whom it makes a great saving of time and distance when communicating with their brethren who have settled in Yarkand. A colony of Baltis have long existed at Yarkand, chiefly engaged in agriculture, and a journey to and from is made each year".

Robert Shaw

Robert Shaw, the first Englishman to reach Kashgar and also a member of the Forsyth mission makes no mention of this route in his book,[10] but in some footnotes in an article already quoted[11] he refers to another route which apparently joins the one under discussion. This is mentioned on page 11 of this report.

H. H. Godwin-Austen

I might here mention a reference in volume 30 of the Asiatic Society Journal. This though not actually concerned with the route under discussion is I think relevant. Referring to the progress of the Kashmir triangulation is a note by H. H. G. A. (Godwin-Austen?) "There are 3 roads from Hunza to Yarkand, one that takes 12, another 8, and another not more than 4 days. The

[8] Journal of the R. G. S. Vol. 40. 1868.

[9] The roof of the World.—T. E. Gordon 1876.

[10] Kashgar and High Tartary.—R. Shaw.

[11] Journal of the R. G. S. Vol. 46. 1876.

last being 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".

T. G. Montgomerie

To this Montgomerie added;—"The routes given from Hunza to Yarkand (though 4 days may be apocryphal) all tend to show that Yarkand must be nearer the longitude of Skardu than Leh, ... and the four days may be given on the strength of the wonderful rapidity with which the Hunza-Nagar people get warning of the Kafilas leaving Yarkand, so quickly indeed was this given that the Hunza-Nagar's were able to make all their arrangements in Hunza and then cross into the Shigar valley and still be in time to rob the Kafilas before they reached the inhabited parts of Ladak and Balti".

Col. Sir F. Younghusband.

The next information, that I can trace, is furnished by Sir F. Younghusband, and this provides the only knowledge that we have concerning the middle portion of the route. He is the only European, with the possible exception of the Russian traveller Grombetski, who has entered the Oprang valley, his discovery of which entirely altered the mapping of the northern slopes of the Kara-koram, which previously had been shown by a succession of subsidiary ranges extending in a north-south direction right down to the Yarkand river.

Describing his journey of 1889, he says,—[12] "I wished on my way there (to the Shingshal pass) to satisfy my curiosity as to the existence of a mysterious pass called the Saltoro pass, which my old guide Wali had pointed out to me in the distance on our way to the Mustagh." And further on, describing the view from the summit of the Aghil pass, he says,—"Away to our eastward, up a glacier which stretched across the valley of the Oprang River at our feet, Wali the guide had told me there was a way of Baltistan by a pass called the Saltoro. No one, apparently, had crossed this pass for many years....." This glacier, which he named the Urdok, he subsequently ascended nearly to its head, but before reaching the pass or col he was forced by bad weather to return.

Sir M. Conway

Conway says-[13] "I was informed by the natives that there is a path leading up the southernmost of the main easterly branches of the Kondus valley, and another out of the Khonken valley, both giving access to the Oprang glacier".

Major K. Mason

There is also a reference to a trans-Kara-koram route in Major Mason's account of the triangulation between India and Russia.[14] This was derived from native information and, if correct, alludes to the Muz-tāgh pass route, or an unknown one to the west of it.

Dr. T. G. Longstaff

We now come to Dr. Longstaff's exploration of 1909. He searched for the pass from the Indian side, and following Vigne's footsteps reached the head of the Saltoro river, and crossing the pass at its head which he called the Saltoro, but is now better known as the Bilaphond La, discovered the upper portion of the Siachen glacier. He found old stone shelters unused for ages, along the route which conclusively proved that previous travellers had used that track. The description of his journey is to be found in the Royal Geographical Society's journal Vol. 35, 1910.

Workmans

Subsequently the Bullock Workmans surveyed the Siachen glacier, reaching it by the Bilaphond La. They found more remains of previous visitors and their book[15] gives a full description of the results of their exploration. They found a possible pass on the watershed which they called Turkistan La and which they considered might be the one at the head of the glacier which Younghusband called the Urdok. They report that it is traversable by a party fitted with Alpine equipment.

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[12] The Heart of a Continent.—F. Younghusband.

[13] Climbing in the Karakorams.—Conway.

[14] Records of the Survey of India. Vol. VI.

[15] Two summers in the Ice Wilds of the Eastern Kara-korams.—Bullock Workman.

Neve refers[16] to native traditions of a pass at the head of the Siachen by which the Kanjuties had at one time reached the Nubra village and De Filippi in his book[17] dealing with the Abruzzi expedition of 1909 reports on possible passes from the Indian side to the Oprang in the neighbourhood of K. 2.

Dr. A. Neve

The explorations of the De Filippi expedition in 1914 have been fully dealt with in this report and need not be referred to again.

Before summing up the material available about this route it should be borne in mind that the condition of the Kara-koram glaciers is continually changing. At one period these conditions may render a passage comparatively easy, to remain so for years until some change effectually bars all progress, which barrier may be removed by some future change. Therefore the fact that the crossing of a pass is impossible now, is no guarantee that it was not open in the past, or that it will not be open in the future, and *vice versa*.

Glacial change

Furthermore it must be remembered that the inhabitants of these regions are very hardy mountaineers, and in pursuit of their own work they are quite prepared to undertake journeys under the most adverse and difficult conditions; but they are also more than ready to deny or conceal all knowledge of a route, if they have the remotest idea that they may be called upon to act as guides or coolies.

Secretive inhabitants

Taking these facts into consideration and with the knowledge we now have, it seems more than probable that in the past an old track did run from Khapalu in Nubra to Khufelang in the Yārkand river and that this followed either the Saltoro valley via the Bilaphond La or the Kondus valley via the Sia La to the Siachen glacier, at the head of which it crossed the Kara-koram range by a pass—possibly the Turkistān La—to the Oprang valley, and thence by a pass across the Aghil range into a tributary, the J stream of this report, of the Yārkand river and thence to Khufelang.

Summary

Whether either of these passes can be used now can only be decided after further exploration.

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[16] 30 years in Kashmir.—A. Neve.

[17] Kara-korams and Western Himalayas.—F. De Filippi.

List of coordinates and heights of stations and points.

Station or Point	Latitude			Longitude			Height above Mean Sea-level Ground level
SHEET 51 H.	°	′	″	°	′	″	*feet*
Black rock in centre of flat snow hill ...	36	04	39	77	02	07	20,090
Cairn on summit of a rocky topped hill ...		03	54·7		11	45·4	18,250
Eastern and highest point of snow peak ...		32	34		16	46	20,850
Highest point of snow peak ...		29	13		28	49	21,040
Kirghiz jangal encamping ground ...		25	28		25	09	12,995
Cairn on peak of a spur above Kirghiz jangal E.G. ...		24	15·1		24	23·5	16,912
Summit of snow peak ...		18	49		19	05	20,790
Snow cone peak ..		18	24		18	46	20,860
Southern end of snow peak ...		18	09		18	13	20,940
Rounded hill. Highest point ...		09	14		28	47	19,310
Highest point of flat-topped hill ...		04	46		19	08	20,000
Highest point of rocky ridge ...		04	11		20	11	19,840
Centre of rounded snow hill ...		03	15		21	09	20,300
Cone shaped snow peak ...		28	55		39	18	20,860
Cairn on summit of hill on left bank of Yārkand R. about 4 miles above Khufelang		08	14·1		37	28·5	17,769
Northern side of rocks at east end of flat peak ...		06	16		42	55	17,790
Highest point of rounded bump on rocky hill		04	54		36	01	18,190
Cairn 200 yds. east of highest point on spur about 8 miles above Khufelang ...		04	41·2		39	37·2	16,759
Extreme W. end of flat-topped peak ...		03	20		31	06	18,940
Eastern of two peaks ...		02	32		42	12	19,300
Western of two peaks ...		02	28		41	51	19,200
Northern of double peak ...		02	24		43	58	18,960
Southern of double peak ...		02	20		43	54	18,960
Cone-shaped peak ...		17	25		48	59	19,950
Rounded hill. Highest point ...		15	57		50	24	19,940
Highest point of ridge ...		15	05		58	46	20,440
Cairn on summit of high hill NE. of junction of Yārkand R. and stream from Aktāgh ...		09	47·7		48	51·5	19,002
Western of double peak ...	36	02	04	77	45	07	19,180
SHEET 51 L.							
Eastern and highest point of ridge ...	36	10	55	78	05	25	20,500
Rounded snow hill ...		10	34		02	13	20,480
Snow peak ...		07	26		08	53	20,510
Snow cone. Eastern end of ridge ...	36	10	37	78	15	42	20,450
SHEET 52 E.							
Eastern side of snow peak ...	35	54	01	77	07	30	21,850
Centre of black rock cap of snow peak ...		53	03		10	29	21,840
Northern and highest point of snow peak ...		34	46		05	04	24,430
Snow cone eastern end of ridge ...		31	09		12	46	23,720
Small cone on west of snow ridge ...		31	08		12	40	23,680
Round-topped snow cone ...		27	46		10	29	22,570
Highest point of rocky peak ...		56	23		26	13	19,180
Highest pinnacle at south end of rocky peak		56	16		28	44	18,800
Centre of round-topped snow peak ...		56	11		16	46	20,600
Rocks at eastern end of ridge ...		56	05		29	58	18,260
Cairn of stones on summit of hill ...		54	57·0		25	19·2	18,508
Rock pinnacle ...		51	52		27	07	19,320
Cone peak ...		50	03		26	27	20,520
Cairn on summit of hill ...	35	49	46·7	77	21	47·1	19,471

List of coordinates and heights of stations and points.

Station or Point	Latitude			Longitude			Height above Mean Sea-level — Ground level
SHEET 52 E. (*Contd.*)	°	′	″	°	′	″	*feet*
Cairn on rocky point of ridge ...	35	47	25·7	77	17	07·4	19,989
Highest snow peak on ridge ...		46	45		26	55	22,190
Eastern of two snow peaks ...		46	45		27	23	22,060
Cone on rounded peak. West end of range		46	33		26	28	22,170
Eastern end of rock and snow peak ...		45	31		21	14	21,110
Cone snow peak ...		45	10		28	28	21,870
Snow peak, eastern end of range ...		45	07		29	05	22,460
Snow peak ...		43	59		26	10	22,440
North-eastern of double peak ...		43	30		17	06	21,510
Highest point of snow peak ...		43	29		17	04	21,520
Snow peak ...		41	21		25	05	22,120
Snow peak ...		40	37		28	43	21,490
South-western end of southern of two flat-topped hills ...		36	37		25	59	21,410
Highest point of snow ridge ...		28	52		16	36	22,380
Rock pinnacle on snow peak. Cliffs on S. side		28	18		23	46	21,910
Rock pinnacle on snow ridge ...		28	17		18	22	22,090
Limestone rock and snow peak ...		27	45		26	50	20,750
Northern end of snow peak ...		24	57		23	03	22,180
Southern and highest point of snow peak ...		24	52		22	45	22,240
Cone-shaped snow peak ...		23	38		23	19	22,560
Rounded snow peak ...		23	09		23	15	22,460
Snow cone. Centre of triple peak ...		22	38		23	04	23,520
Sharp cone at southern end of snow ridge		22	32		21	38	23,730
Southern of twin peaks ...		21	22		22	09	24,230
South-western summit of a double snow peak		19	46		23	00	21,840
Snow peak ...		18	48		22	07	22,300
Cairn on summit of hill overlooking Yārkand river ...		59	04·6		30	48·5	17,525
Cairn on top of hill on right bank of Yārkand river ...		58	31·6		37	18·5	17,874
Cone at north-eastern end of ridge ...		58	13		38	38	18,530
Rounded hill. Highest point ...		57	56		38	32	18,590
Pinnacle in centre of ridge ...		57	53		37	52	18,380
Western end of ridge ...		57	44		38	21	18,580
Rock pinnacle at eastern end of ridge ...		57	30		38	04	18,550
Southern of two humps on peak ...		54	27		39	05	19,270
Rock on summit of cone-shaped peak ...		52	34		30	41	18,290
Summit of rock peak at northern end of ridge		52	22		42	35	19,650
Centre of rounded peak. Northern of two ..		52	00		43	11	19,550
Spike of limestone rock on ridge ...		51	28		33	25	18,920
Cairn on summit of high peak on eastern bank of Yārkand river. ...		51	10·5		38	17·7	18,618
Highest point of rocky ridge ...		49	17		32	14	19,810
Highest point of limestone spike ...		45	26		40	29	19,030
Rounded peak at southern end of ridge ...		45	06		39	53	19,090
Cairn to west of rocks on summit of hill on western bank of Yārkand river ...		44	27·2		41	48·1	17,745
Rock pinnacle. Extreme west end of ridge ...		43	41		38	32	20,880
Snow summit at centre of range ...		43	20		40	00	20,080
Rocky cliff at southern end of range ...		43	12		40	26	19,680
Rock on summit of limestone peak ...		41	34		44	38	20,500
Centre of highest peak on ridge ...		41	17		30	49	22,220
Rock on centre of rounded hill ...		41	16		37	54	19,990
Rock on centre of rounded hill ...		40	59		38	03	20,080
Cone shaped snow peak ...		40	46		31	59	21,160
Rounded top of cone snow peak ...		40	46		31	15	21,450
Cairn on southern and lowest of three peaks on ridge ...	35	40	21·5	77	43	04·1	18,207

List of coordinates and heights of stations and points.

Station or point	Latitude			Longitude			Height above Mean Sea-level: Ground level
SHEET 52 E. (*Contd.*)	°	′	″	°	′	″	*feet*
Cairn on highest point of outer range of hills on left bank of Yārkand river near lake	35	40	02·7	77	39	45·9	18,426
Low hill near lake ...		38	05		40	19	16,420
Cairn on east edge of crest of a conical hill west of lake ...		36	34·9		36	43·3	19,056
Highest of double peak ...		35	21		44	17	20,070
Centre and highest point of ridge ...		35	20		44	10	20,100
Limestone pyramid near north end of ridge		34	35		39	16	19,630
Centre and highest point of ridge ...		33	30		39	53	19,920
Small rock on highest point of peak ...		33	25		33	15	20,450
Rock peak on south end of range ...		33	03		40	41	19,850
Southern and higher of double snow peak ...		31	10		34	22	20,830
Highest point of rock peak ...		30	51		32	58	19,980
Cairn on highest point of peak on watershed overlooking north snout of Remo glacier		29	10·2		30	46·6	18,874
Red limestone rock peak ...		29	03		34	12	20,440
Higher and northern of double snow peak ...		28	31		40	00	20,510
Centre of southern of double peak ...		28	14		40	10	20,410
Cairn on summit of rounded hill on Shyok-Yārkand watershed ...		28	01·6		44	50·6	19,923
Cairn north of large rock on summit of ridge		26	44·5		41	31·5	19,877
Rock on flat-topped hill ...		25	47		43	37	19,650
Cairn near spike of rock on low rocky ridge on left bank of NW. branch of Remo ...		22	31·8		38	37·1	18,910
Cairn on centre of 3 low hummocks close to left bank of NW. branch of Remo glacier		21	53·1		38	19·7	16,932
Rock peak on ridge S. of Remo glacier ...		21	09		41	22	19,120
Cairn on west of a double hill at SW. end of a group of low hills near junction of Shyok and Chip-Chak rivers ...		19	51·6		44	12·5	16,545
West point of rock pinnacle ...		18	44		38	45	19,420
Highest point of rounded top of snow cone		17	12		32	26	21,420
Rocky pinnacle on snow ridge ...		16	37		40	40	20,270
Cone-shaped snow peak ...		16	29		32	51	20,790
Highest point of snow ridge ...		14	45		38	13	21,730
Rocky peak at west end of ridge ...		14	40		30	26	21,120
Cone at east end of ridge ...		14	33		30	57	21,180
Black rock on top of snow peak ...		11	57		32	30	22,980
Snow peak ...		11	41		35	14	23,200
Snow peak ...		09	19		33	47	22,040
Summit of snow peak ...		08	51		37	26	22,520
Black rock on summit of snow peak ...		08	34		34	45	24,660
Rounded snow peak ...		07	51		38	37	21,820
Snow peak ...		05	19		40	45	22,110
Cairn on conical hill SW. of Ak-tāgh encamping ground ...		59	37·5		57	14·5	17,978
Rock pinnacle ...		58	56		48	27	19,510
Highest point of flat-topped hill ...		58	34		48	44	20,150
Rounded rock at east end of peak ...		58	23		53	01	19,730
Rock pinnacle ...		57	20		51	06	19,530
Cairn on summit of high hill south of Ak-tāgh encamping ground ...		57	12·1		56	55·8	18,920
Round peak at west end of range ...		49	32		46	46	19,380
Flat black rock on east end of range ...		48	55		47	53	19,640
Cone on rocky ridge ...		48	30		53	23	19,940
Sharp peak ...		48	22		49	03	19,480
Northern of double hump on highest point of ridge ...	35	47	38	77	49	42	20,000

List of coordinates and heights of stations and points.

Station or point	Latitude			Longitude			Height above Mean Sea-level — Ground level
SHEET 52 E. (*Contd.*)	°	′	″	°	′	″	*feet*
Southern of two rock humps at south end of range ...	35	47	04	77	50	18	19,850
Cairn on highest point of rocky ridge ...		45	04·8		51	08·6	18,487
Cairn on summit of hill at SE. end of spur		44	57·3		46	13·6	17,766
Centre of rocks on summit of cone hill ...		44	52		47	03	18,390
Cairn on highest point of ridge west of Baksam-bulak camping ground ...		43	15·5		56	53·6	19,077
Highest point of rounded hill ...		41	43		50	27	19,850
Rock pinnacle ...		40	42		52	26	18,660
Snow peak ...		36	03		57	27	20,990
Centre of large rock on rocky peak ...		35	35		48	51	19,980
Highest point of peak ...		35	23		48	14	19,730
Pointed snow peak ...		35	15		52	19	20,230
Pointed peak on south end of spur ...		34	05		45	39	19,820
Snow peak ...		32	50		57	37	20,660
Highest point of peak ...		32	03		47	52	19,910
West edge of rocky snow peak ...		31	28		49	30	19,600
SW. corner of boundary pillar on the Kara-koram pass ...		30	50		49	33	18,270
Cairn on summit of hill due south of the Kara-koram pass ...		30	39·6		49	36·3	18,605
Snow cone peak ...		30	22		54	01	20,000
North end of snow peak. Cliffs to north ...		30	18		45	23	19,980
Summit of rounded hill ...		30	09		46	02	19,700
Highest point of peak ...		29	54		48	02	19,470
Western end of rocks on ridge ...		28	38		52	09	19,600
Rock pinnacle ...		27	24		46	39	19,950
Highest point of hump on south edge of peak ...		27	10		59	06	19,770
Solitary cone peak ...		26	12		57	35	19,690
Cairn on top of hill west of Pulo huts ...		25	57·0		52	36·5	18,754
Snow peak ...		25	32		59	22	19,510
Highest point on rounded bump at N. end of peak ...		25	27		49	35	19,070
Cairn on highest point of rocky ridge ...		24	50·3		50	16·1	18,960
Cone-shaped peak ...		24	27		59	18	19,340
Cairn on highest of detached hills on west end of Depsang plateau ...		19	09·3		55	24·9	18,753
Cairn on highest point of ridge towards west end of Depsang plateau ...		18	15·9		56	13·0	18,518
Cairn on highest point of rounded hill on west end of Depsang plateau ...		18	10·6		52	14·3	18,079
Cairn marking site of astronomical station on Depsang plateau ...		17	23·6		58	23·8	17,591
Cairn on west end of low ridge near west edge of Depsang plateau ...		17	20·5		56	48·9	17,895
Limestone pinnacle ...		14	31		48	52	19,720
Snow peak ...		10	32		53	49	20,190
Western summit of "The Depsang Peak" ...		10	18		49	20	22,640
Eastern and highest summit of "The Depsang Peak" ...		10	16		49	56	22,750
South-eastern of double snow peak ...		09	59		48	26	21,500
Rocky peak on snow mountain ...		09	51		46	09	21,030
Rounded snow peak ...		09	01		48	35	21,370
Southern of three humps on snow ridge ...		08	40		47	09	20,940
Summit of snow peak ...	35	05	18	77	55	21	21,830
SHEET 52 F.							
Pointed snow peak ...	34	52	25	77	44	18	24,330

List of coordinates and heights of stations and points.

Station or poin	Latitude			Longitude			Height above Mean Sea-level
							Ground level
SHEET 52 F. (*Contd.*)	°	′	″	°	′	″	*feet*
Site of Leh astronomical station of the expedition. 50 yards east of dāk bungalow ...	34	10	08·6	77	35	04·4	11,554
Pillar about 200 yards from SW. corner of Residency compound at Leh ...		10	06·2		34	49·7	11,508
Cairn on a lower peak on ridge SW. of Shaksaling. ...		09	05·4		36	04·0	12,370
House at west end of Pittuk Gompa ...		07	36·1		31	36·5	10,788
Rock island in Indus river ...		00	38		41	20	11,060
Hump at western end of snow peak ...		52	00		45	13	25,280
Cairn on ridge west side of the Chimré-Zangrol *nālā* ...	34	01	25·5	77	51	20·6	16,579
SHEET 52 G.							
Cairn on ridge on west of Chimré *nālā* ...	33	57	41·8	77	44	49·7	12,823
Western of double peak ...		54	32		38	08	18,710
Highest point of flat snow ridge ...		54	47		56	38	19,540
Northern end of snow ridge ...		53	10		55	57	19,090
Rock peak ...	33	51	28	77	54	07	17,770
SHEET 52 I.							
Cairn on rounded top of highest of an isolated group of hills south of Sari-kol encamping ground ...	35	47	14·1	78	02	07·6	18,329
Rock pinnacle ...		37	42		00	46	19,860
Summit of rocky peak ...		29	21		02	40	20,140
Centre of rounded peak ...		23	33		05	53	19,460
Highest point of rocky ridge ...		20	23		04	20	18,540
Cairn on highest point of low range near NW. end of Depsang plateau ...		18	47·0		00	53·2	18,029
Cairn on southern and higher of double hump towards NW. end of Depsang plateau		16	27·6		00	49·0	17,911
Snow peak ...		14	28		13	01	20,340
Rounded snow peak. Highest point ...		44	04		24	36	21,290
Summit of rounded snow peak ...		33	09		20	52	21,070
Rounded snow peak ...		32	08		21	03	20,990
Highest hump of many on ridge ...		32	01		21	15	20,720
Cone peak in centre of range ...		19	58		22	56	19,940
Snow cone peak ...		13	39		19	09	21,410
Centre of flat snow peak ...		12	05		18	48	20,830
Snow peak ...		06	20		18	03	21,260
Northern of double snow peak ...	35	51	27	78	41	33	21,560
SHEET 52 J.							
Highest point of a flat snow ridge ...	34	56	29	78	11	06	22,440
Pointed rock on highest point of ridge north of Kataklik encamping ground ...		55	52		05	42	17,540
Cairn about 150 yards south of Shyok village serai ...		10	38·1		08	29·7	12,136
Large flat rock near junction of the Inchin-Lambā stream with the Shyok river ...		09	55·2		06	55·4	16,677
Southern of two cairns on spur east of Shyok village ...	34	09	38·7	78	09	28·4	12,456

View S. W. and W. from h. s. above Baksam-bulak. (λ. 35°, 45′; L. 77°, 51′; H. 18,487 feet.) *Vide* page 11.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

Entrance from Yārkand river to stream leading to the Yangi-dawān. *Vide* page 23.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

View N. E. from h. s. above Kara-Koram pass. (λ. 35°,31′; L. 77°,50′; H. 18,605 feet.) *Vide* page 14.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

View W. and N. W. from summit of Suget pass. *Vide* page 14.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

The Yārkand river below Khufelang. *Vide* page 17.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1922

View E. and S. from h. s. near junction of "I" valley with Yārkand river. (λ. 35°, 55′; L. 77°, 25′; H. 18,508 feet.) *Vide* page 19.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

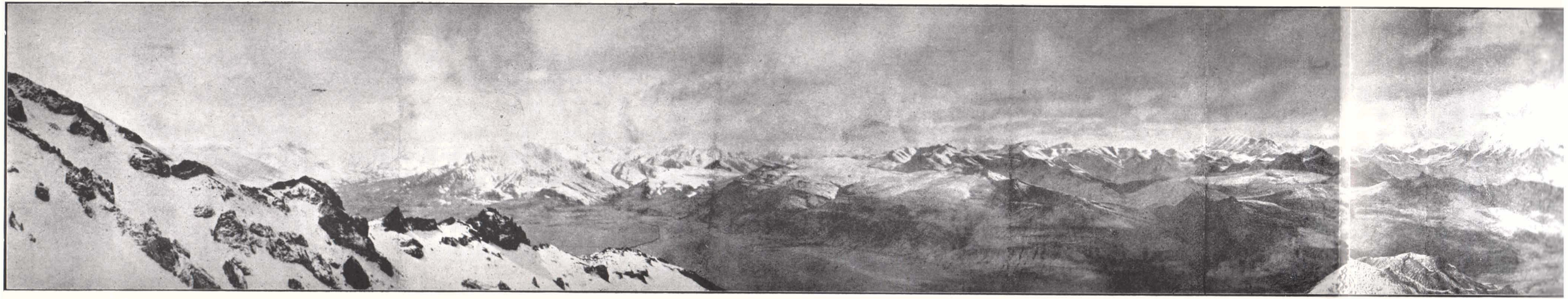
Panorama 7. (continuation of No. 6.)

View N. E. to S. from h. s. at furthest point reached up "J" stream. (λ. 36°,04′; L. 77°,12′; H. 18,250 feet.) *Vide* page 20.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922.

om W. through N. to E. from h. s. on right bank of Yārkand river. (λ. 35°,59′; L. 77°,37′; H. 17,874 feet.) *Vide* page 22.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922



View from W. through N. to E. from h. s. on right bank of Yārkand river. (λ. 35°,59′; L. 77°,37′; H.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1922

K'un-lun pk. (λ. 36°, 33′; L. 77°, 17′; H. 20,850 feet.)

—N.

K'un-lun pk. (λ. 36°, 29′; L. 77°, 29′; H. 21,040 feet.)

—E.

View from N. W. through N. and E. to S. from h. s. above Kirghiz jangal camping ground. (λ. 36°, 24′; L. 77°, 24′; H. 16,912 feet.)

E.

S.

E. to S. from h. s. above Kirghiz jangal camping ground. (λ. 36°, 24′; L. 77°, 24′; H. 16,912 feet.) *Vide* page 23.