

The Geographical Representation of the Mountains of Tibet.

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(Received March 18, 1930.)

Tibet is the great protuberance of the Earth's surface, and many branches of science rely upon geographers for the accurate representation of its features. The most definite features of mountain masses are the high peaks, and the determination of their positions is the first geographical step. As the area of Tibet exceeds a million square miles, it has been necessary to classify its myriads of peaks, and the method of classification adopted has been to group the peaks according to the mountain ranges upon which they stand. Geographers have utilised the ranges as their basis of classification, and geologists have relied upon the curvatures of the ranges in their consideration of the pressures which have caused the uplift of the continent of Asia. By "ranges" we mean features of original structure; a line of mountains that has been carved by rivers out of an older mass we call a "ridge."

The southern wall of Tibet is the range of the Himalaya which separates it from India. The northern wall is the Kuen-Lun range which separates it from Turkestan. Between these two border ranges the Karakoram forms the central backbone which is the second highest range of mountains upon the earth. The width of each of these ranges is of the order of 100 miles. In this paper I am considering the form and the alignment of the Karakoram range, and I will divide this consideration into three sections: (1) The alignment; (2) the northern slopes; (3) the southern slopes.

(a) *The Karakoram Alignment across Western Tibet* (1865).

(See Map I.)

The alignment of this range has proved more difficult than that of the Himalaya. The latter rise out of the low-lying plains of India and are so conspicuous that all other features are dwarfed. But the Karakoram rise from a plateau, where the ground-level is 16,000 feet high, and only the highest features emerge above the surface of the table-land. In tracing the course of such a range we have to rely upon three classes of observation: (i) altitude; (ii) the lines of drainage; (iii) the continuity of the curvilinear alignment.

The main features of the Karakoram were determined in 1855-1865 by Colonel Montgomerie's surveys, and are shown here in map I. The crest-line

of high peaks extends from A on the map to E, a length of 170 miles. The peaks are named as follows :—

A—group of 4 Hunza-Kunji peaks, 3 of which exceed 25,000 feet.

B—group of 3 Kunjut peaks, one of which exceeds 25,000 feet.

C—the peak of K2, the second highest point on the globe, height 28,250 feet.

D—Teram Kangri peak, height 24,430 feet (discovered 1909).

E—peak near the Rimo glacier, 23,320 feet (discovered 1914).

From F to G, a length of 110 miles, there is another line of peaks somewhat lower, and 20 miles distant from the higher crest-line. The probable explanation of this parallel line is that the original summit was a wide flat-topped zone. A difference noticeable between the Himalayan and Karakoram maps is that the glaciers of the former tend to flow in directions transverse to the range, whilst those of the latter have formed longitudinal beds. This difference is probably due to the original formations of the summits.

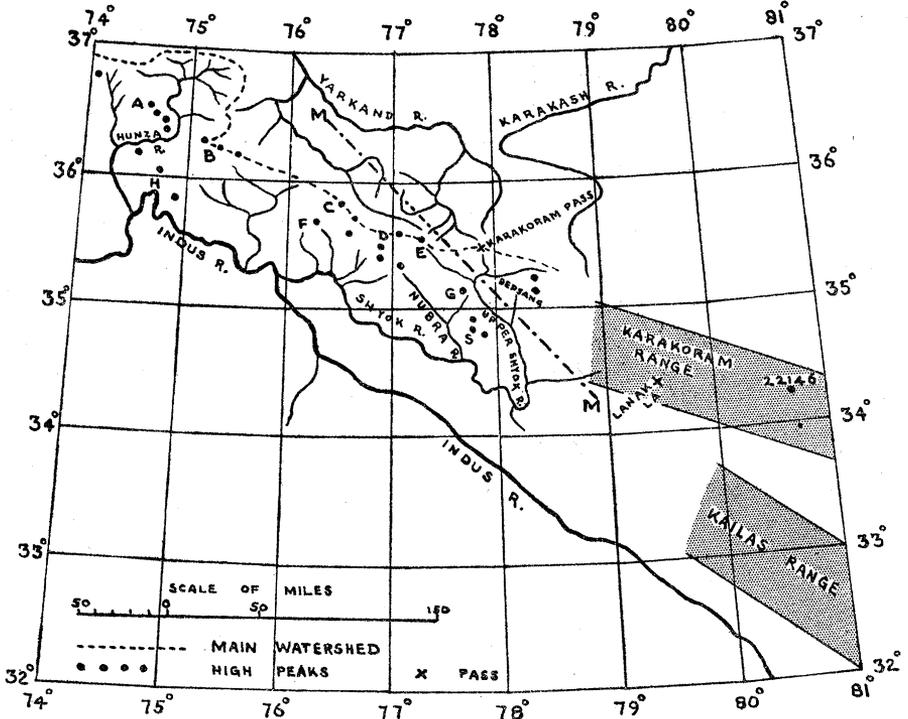
The watershed between the drainage basins of the Indus and Yarkand rivers is shown on map I by a dotted line. This is the Central Asian divide ; for a length of 140 miles it coincides with the Karakoram crest, but on the west and on the east, in Hunza and Depsang, the feeders of the Indus have cut back and have caused the watershed to recede behind the crest to a distance of 40 miles on the west, and of 20 miles on the east in Depsang.

From A to E the crest-line is so lofty that from longitude 74° to 77° the alignment is not open to doubt, but east of the Rimo peak at E the following changes in the topography occur together :—

- (1) The crest-line decreases in height, and peaks of 23,000 feet are no longer seen.
- (2) Owing to the rainfall on the southern slopes being heavier than on the northern, the Upper Shyok river has been able to cut back through the range and to capture a small drainage area, Depsang, from the Yarkand river.
- (3) East of the Shyok river the rainfall almost ceases, and the river is replaced by inland lakes. The Central Asian divide gives place here to the inland basin of Tibet. The erosion by glaciers and rivers which has given to the Karakoram range its sharp and rugged character also ceases, and in the dry climate of Tibet the decomposition of rock fills the hollows with sand and gives to the mountains a rounded appearance.

(b) The Prolongation of the Alignment into Central Tibet (1874 to 1909).

In 1870 the opinion held by Colonel Montgomerie was that from longitude 74° to 77° the range was aligned as shown in map I, and that near longitude 78° the range was cut across by the gorge of the Shyok river, and that its easterly prolongation was not known. In 1874 the survey sent the pundit Nain Singh to explore Central Tibet, but his explorations were begun south-east of Montgomerie's surveys, and no connection was established

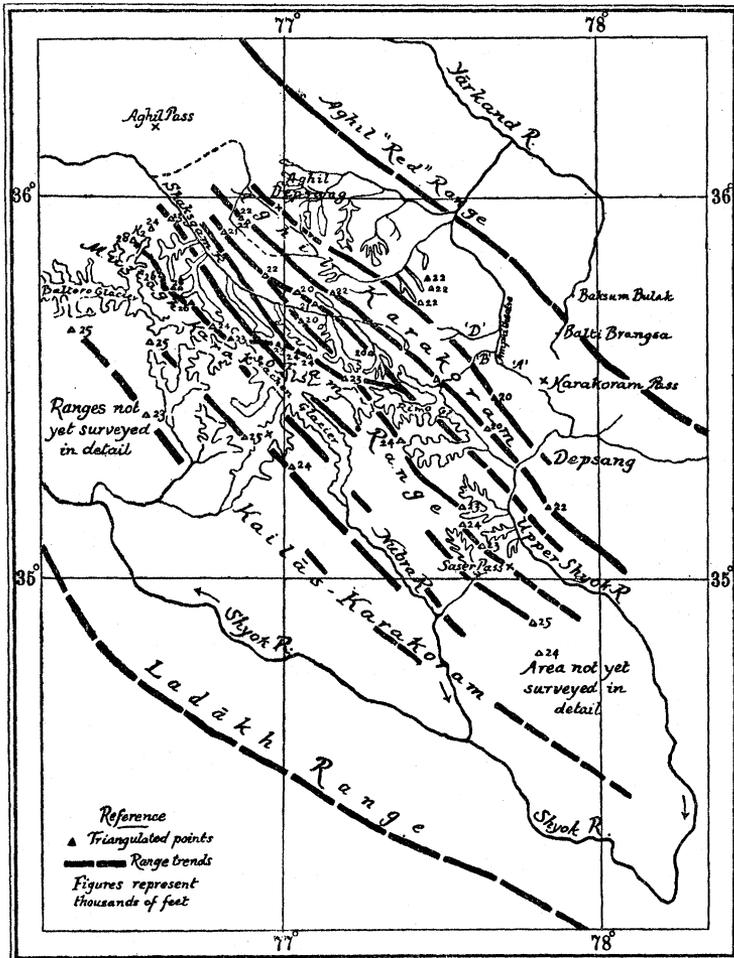


MAP I.—The alignment of the Karakoram range as shown upon maps prior to 1928.

between the two. Nain Singh's route lay to the east of map I, in latitude 32° ; he was impressed by the high snowy range he saw to his south. This range was 120 miles north of a range known as "the Kailas," which had been fixed by earlier explorers, 1846–1850. (Many years later, 1904–5, Ryder and Wood made a survey of the Tsangpo river in southern Tibet and observed peaks on the Kailas range between latitude 29° and 30° .) The view adopted by the Survey, 1878 to 1880, was that Nain Singh's range was probably the easterly continuation of the Karakoram. The possibility of such a continuation was faintly indicated in the map of the Mountains of India, prepared

for the House of Commons, 1880. Up to 1908, however, the range-lines were broken on charts to show that their continuity was hypothetical.

In 1909 Sven Hedin published the results of his explorations in Tibet, 1906 to 1908. He had explored the whole country between Nain Singh's range and



MAP II.—The alignment of the Karakoram range as shown in 1928.

the Kailas range, and he had discovered that these two apparent ranges were the north and south borders of one great range, over 100 miles wide. This immense range was called by Sven Hedin the Trans-Himalaya. He showed that the Trans-Himalaya embraced the range, known to the Survey as the

“Kailas.” In his book published in 1909 Sven Hedin also showed that the prolongation of the Karakoram range through Central Tibet was 2° further north than had been thought. On the north his explorations fitted in with those of Deasy and Rawling. The straightening of the eastern prolongation of the Karakoram range by Sven Hedin enables us with confidence now to continue the alignment of this range to the eastern limit of map I.

(c) *Recent Confirmations of Montgomerie's Alignment (1908 to 1922).*

In 1909 Dr. Longstaff explored the Karakoram crest; near the point D on map I he found that a bay in the watershed, 30 miles across, had arisen from an error in the original survey of the Siachen glacier. By this discovery Longstaff straightened out the watershed, and showed that it conformed to the crest-line. Also by his further discovery of the peak of Teram Kangri he proved that the high crest-line was continuing on the same alignment, as it had followed from Hunza to Gasherbrum.

Since 1914 the surveys of de Filippi and Wood* have given additional confirmation to the correctness of the accepted alignment. Their maps of the Karakoram watershed (well-known in geography from the Karakoram pass that crosses it) shows that this watershed is a “ridge” carved out of the northern slopes of the Karakoram range.

(d) *The New Alignment advocated in 1928.*

In 1928 a Report on the “Exploration of the Shaksgam Valley” by Major Mason was published by the Geodetic Branch Office of the Survey of India. In this report the alignment of the Karakoram range, as described in this paper and as illustrated in map I, has been altered. Map II of this paper is a copy of the map given in the report to illustrate the new alignment. The two maps can be compared, as the high crest-line on map I can also be seen on map II running from the point marked K2(28) to the Rimo glacier (across three of the new alignments); the Karakoram pass is also shown on both maps. I had to draw map I on a smaller scale than map II, because it was necessary to embrace a larger area in order to test the results of the new changes. Major Mason has complicated map II by introducing many ranges, where his predecessors had shown only one. The high crest-line in map I trends from W.N.W. to E.S.E.; the range-lines of map II trend from N.W. to S.E. The change in direction amounts to 20° , and in order to illustrate its effects I have

* Colonel Wood worked with the de Filippi expedition, 1913-14.

drawn on map I one of Mason's new lines and marked it M-M. This line on map I enables the proposed change in the Karakoram alignment to be appreciated. Major Mason's several range-lines are more or less parallel, and the range which I have copied from map II into map I is that which runs from Aghil Depsang to Depsang. Major Mason, referring to the old alignment which had been adopted by his predecessors in consultations with geologists, writes as follows : " The Karakoram range has been allowed to cut across the mountains that I have shown as belonging to the Aghil chain." And he goes on to say that his " conception of the Aghil chain must necessarily change all this."

The Surveyor-General (Brigadier E. A. Tandy) expressed his approval of map II in the preface which he contributed to the report. He drew attention to the special interest attaching to " the great divide between the drainage of Central Asia and the Indian Ocean," and he added that " the interesting character of the drainage can best be studied " from map II. A study of map II shows that five of the new ranges have been made to intersect the " great divide," as if drainage was independent of altitude. On map II the Karakoram pass, which is on the great divide, seems to be standing on nothing.

My objections to Major Mason's alignments may be summarised as follows :—

- (1) His mountain ranges have no relation to the drainage.
- (2) His ranges are shown cutting across the high Karakoram crest-line which is the dominant feature of the region.
- (3) His alignments if prolonged beyond the western and eastern borders of his map II become further and further removed from the real Karakoram range.

The map showing Mason's new alignments has been given wide publicity. I take this opportunity of advising geologists and meteorologists and all who are interested in small-scale maps to consider the questions at issue before they accept the new geographical representations.

(e) The Northern Slopes of the Karakoram.

Between 1890 and 1900 the idea came to be held that a separate range, the Aghil range, was standing north of the Karakoram, between the latter and the Kuen-Lun. There were grounds for believing that high mountains were standing there. The possibility of an Aghil range was occasionally indicated on maps, but without further surveys it was known to be hypothetical. In 1914 Colonel Wood made a survey of the Central Asian divide and of a

considerable area beyond. His map showed that there was no Aghil range. The ground level is high and rugged, but not more so than is to be expected, when we consider that it is the flank of the second highest mountain chain in the world. The general slope of the ground is downwards from the Karakoram crest to the Yarkand river, and this is an indication that the whole area was involved in the crustal fold which raised the Karakoram. Not only does the ground slope gradually downwards, but its highest points, a few of 22,000 feet and one of 23,000, occur immediately opposite that section of the Karakoram crest in which the greatest altitudes have been observed. The ranges of Tibet are the governing lines of the plateau, and it appears from Wood's and Mason's surveys that there is no such governing line in the Aghil area. The evidence furnished by the drainage leads to the same conclusion, for the feeders of the Yarkand and Karakash rivers flow straight away from the main divide without encountering any serious obstacle.

The interesting problem of the Aghil area is the deep trough of the Shaksgam river; it was discovered by Sir Francis Younghusband in 1887. That this trough owes its origin to the glaciers of the Karakoram seems beyond doubt, for it only exists, as a trough, below that section of the range (from C to D on map I) where the altitude of the range is greatest. The drop from the crest to the trough is abnormally steep, but it cannot be said to be unique; there is an equally steep drop behind the Himalayan peak of Dhaulagiri, and there may be other similar instances.

The "Karakoram pass" has had an important place in geography. It is the only feature of the country that has been well known for centuries to the travelling population of Ladak and Turkestan, and it has been a landmark in modern geography. From 1865 to 1880 the opinion held by the Survey of India was that the Karakoram pass was situated north of the mountain crest upon a minor ridge, to which the Shyok river had been able to cut its way from the south. From 1890 to 1900, when the existence of an Aghil range in rear of the Karakoram was considered probable, an idea grew up that the Shyok river might have cut back into the trough between the two ranges. This idea was conjectural and had been borrowed from the Himalayan analogy; a trough exists behind Mount Everest and Dhaulagiri, into which the rivers draining the front Himalayan slopes have been able to cut back. The publication of de Filippi's and Wood's surveys has taught us that no trough exists behind the Karakoram. Their maps showed that the Karakoram pass is situated on a ridge in rear of the crest-line, and that this ridge has probably been carved by the Shyok tributaries out of the massive flank of the range.

An interesting confirmation of this view is to be obtained also from de Filippi's map* ; he shows that the Rimo glacier is situated upon the great divide, so that on one side it is feeding the Yarkand river and on the other it is feeding the Indus. The idea is thereby suggested that the watershed is receding northwards, and that in its recession it has robbed the Yarkand river of a part of the Rimo glacier, and that it will in time rob it of all.

(f) *The Southern Slopes of the Karakoram.*

The southern slopes present more difficult problems than the northern. Not only does the great range of southern Tibet come into contact with the Karakoram range, but there are two isolated masses surmounted with high peaks, marked upon map I as S and H, which cannot be allotted with certainty to either of the two ranges. The Kailas range is the prominent feature of Southern Tibet from east to west ; its position is shown on map I near the south-east corner. Sven Hedin describes this range as it traverses Central Tibet as follows : " It is 1400 miles long ; in breadth it is inferior to the Himalaya, and its peaks are lower, but the height of its passes are greater than those of the Himalaya. On the north and south its boundaries are sharply defined." Nain Singh observed its northern boundary, Ryder and Wood surveyed its southern flank from the Tsangpo.

On map I the Karakoram and Kailas ranges are seen to be converging towards one another, as they trend westwards. As far as we can judge from surface observations, these two ranges must be in actual contact when they reach the Upper Shyok river (longitude 78°). What happens to them when they meet cannot be discovered without geological investigations. Along the line of their contact we see the two high isolated ridges, the Sasir and the Haramush, marked S and H ; such isolated masses, 25,000 feet high, are abnormal in that they do not occur in the Himalaya so far from the crest-line. There are reasons for thinking that there is an interrelation between the two ranges and the two isolated masses ; the Sasir mass, S, rises out of the flank of the Karakoram range where the latter comes into contact with the Kailas ; so long as the two ranges remain in actual contact, the Karakoram attains an altitude considerably higher than anywhere else. Finally when the two ranges again separate, as they appear to do in Hunza (longitude 75°) the Karakoram declines in altitude whilst the second isolated mass, known as Haramush ridge, H, rises like the Sasir mass out of the flank of the range.

* 'Spedizione Italiana de Filippi,' ser. 2, vol. IV, pl. XI.

Geographical surveyors have to draw their conclusions from observations of the Earth's surface. The valuable testimony of the rocks out of which the mountains have been built is not available. But the geological results of the de Filippi expedition will shortly be published. The requirements of nomenclature occasionally lead geographers into the regions of hypothesis; in the course of the long Karakoram investigation the hypothesis was at one time adopted that Nain Singh's range was the easterly prolongation of the Karakoram, but this was afterwards shown to be wrong. Such an hypothesis serves, however, a temporary purpose, in that it shows the way for future research.

When two great earth-folds like the Karakoram and Kailas come into contact and become temporarily merged, it is not possible from surface observations to discover exactly what has happened. But the necessities of classification and of nomenclature have been pressing the Survey to include the two isolated mountain masses, Sasir and Haramush, in their system of ranges, and to allot them either to the Karakoram as spurs, or to the Kailas as high points of its crest-line. But any such steps, though in some ways helpful and suggestive to future surveyors, are merely hypotheses. Our inability to understand the complexities of the orography should not, however, lead us to minimise the great amount of geographical knowledge that has been built up during the last 100 years, or to forget the debts that we shall always owe to the self-sacrifice of the geographical explorers.
