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The Mountain Systems of the Himalaya and Neighbouring Ranges of India

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various purposes. The country is also suitable for cattle-breeding, since the tsetse fly is not met with here. The transport of goods to the coast, which is accomplished in ten days, can be done almost entirely on asses, and Masai asses are stronger and more capable of fatigue than those from Unyamwesi. Dr. Fischer's caravan had forty of them, and they acquitted themselves well with loads of from 150 to 180 lbs.

In conclusion, Dr. Fischer exhibited some photographs, chiefly landscapes, and also the twenty new species of birds which he had obtained in the Masai country. The greater part of his collections were expected to arrive about the end of the month by sailing ship. All the collections, among which the ethnographical is said to be especially copious, were to be publicly exhibited in Hamburg in January 1884, and were intended afterwards to be placed in the museums of the city.

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*The Mountain Systems of the Himalaya and neighbouring Ranges of India.*

By Lieut.-Col. H. H. GODWIN-AUSTEN, F.R.S., &c.

Map and Sections, p. 112.

THE map and sections now submitted were prepared with a view of illustrating a portion of my address to the Geographical Section of the British Association, at Southport, last autumn. The address has been already published in the 'Proceedings';\* but, without a map on a scale sufficiently large and with the mountain features accurately defined, it was hardly possible to give a clear idea of the different lines of elevation. This map has been reduced by photography from one compiled in the Surveyor-General's Office, Calcutta, which gives the topographical detail of all the known areas with great clearness. The sections have been reduced from the original on the scale of four miles to the inch, compiled from the North-west Himalaya and Kashmir Survey maps and memoirs of the Geological Survey of India, and my own journals. These will, I trust, enable the reader to follow the different ranges throughout their whole extent, and compare the relationship they hold to each other. Wherever the country is unknown, such as in that great breadth of Nipal territory between Gurhwal and Sikkim, the lines being conjectural are dotted. The only clue to the continuity of the axis line 4 N, far to the eastward, viz. the Baralasa to the Niti Pass line of subsidiary elevation, is derived from the following facts: 1. The persistence of similar physical features in the north-west Himalaya succeeding each other and being continuous respectively for so many miles on the strike of the main mass. 2. Sir Joseph Hooker's observations north of Sikkim, after he had crossed the extensive granite and gneiss of the main range

\* Proceedings R. G. S., 1883, p. 610.

he came, he says, on rocks of quite a different and newer aspect, nummulites even are mentioned; therefore he, apparently, had got upon the southern edge of deposits similar to those found in Ladak. If this should prove to be the case, i. e. like the section at the Baralasa Pass in Rupshu, then neither the water-parting at the head of the Sikkim Valley, nor that of similar valleys on the west in Nipal, could be accepted as a distinct main axis, or range, and separable, as such, from the line of high peaks, Kinchinjunga, &c.

Again, considering the sections of this great range from a broad point of view, there is also the fact of the old palæozoic basins conforming, on the whole, to these lines of elevation. Take that of Skardo for instance. There we find the carboniferous crushed up against the gneiss of the great Deosai Plateau at the Burji La, and repeated on the other side of the valley near Shigar, continuous respectively to the north-west in the Turmik Valley and the Nushik La at the head of the Kéro glacier, the pass leading into Hunza-Nagar, where I last observed these limestones. On the south-east the same formation is continuous over the Tusserpo and Thullé passes, to the junction of the Húshe river with the Saltoro, beyond which I was unable to trace it, as it was on the margin of the season's survey allotted to me by Captain Montgomerie. Yet further, this extensive basin, of 100 miles on its longest axis, probably extending far to the north-west through Yasin, I take to be represented by the limestones of the Pangkong Lake at its north-western end and the stratified series of the south shore on the east and west direction of that lake before reaching Ote. The carboniferous and superincumbent series of Pal at the other and eastern end, Tso Nyak, lying as it does on the north of the Marsémik gneissose axis which strikes the lake at Silung, belong to, and are connected with, the similar formations of the Changchenmo Valley, and these last, on the far north-west, correspond to the limestones and sandstones to the north-east of the Nobundi Sobundi glacier, near the Mustakh Pass.

Pages might be written on the connection of the Zaskar basin with that of Gurès, but it would be entering too much into details, far better handled in 'The Geology of Chumba and Kashmir Territory,' by Mr. R. Lydekker, a record of many arduous field seasons, most ably done, and of vast interest to all geologists and to those who know the country.

It is, while engaged on the consideration of these mountains, that we can form some idea, though it be a very misty one, of the distribution of the land in palæozoic and mesozoic times. Thus the Deosai and the Ladak ranges, and the Zaskar would appear to have been raised at a very early period, and around them the carboniferous was deposited. Conglomerates in these early formations point to not far distant land. The existing parallelism of the ranges had not yet been defined, and these deposits, now so contorted and elevated, covered a far wider field horizontally, as did also the land they skirted. Later, in early tertiary

times, the present parallelism of the ranges had been developed; and south of the Ladak gneiss, a nummulitic sea ran, as a gulf, up the Indus valley, with probably the more open ocean to the eastward. The areas or basins, now filled with these sedimentary rocks, I have roughly defined in the sections by long arrows between their bounding ranges of gneiss and altered slates, in order to elucidate the cause and effect of the gradual development of this great elevated surface.

The main ranges are shown in broader lines of colour than those which are subsidiary; thus I have indicated by a broad line in the Ladak country the gneiss of the lofty range south of Padam (4. The Zaskar); here the main water-parting, and in my opinion an old axis line, and the main one of the Himalaya (*vide* Section A). The older slates, carboniferous and triassic limestones of the mountains to the north are, clearly, crushed up against it, producing the line of mountains (IV. N) which, further east, become often the line of the water-parting between the rivers that flow direct to the plains and the tributaries of the Indus, owing to the greater denudation of the gneissic rocks (Sections B and C). But it must not be accepted that because this has now become the main water-parting, therefore it is the main axis line, in the sense of a mountain chain; it is a part of it, the result of it, and must not be separated, even supposing that the highest isolated peaks of the range were situated on it. It is impossible to expect an exposure of a primitive rock such as granite or gneiss to be always homogeneous, or to possess the same degree of hardness along its strike, for miles, and this is only one element in the argument, for original extent of elevation is another. In nature we find the truth of this; the bosses or tors of Dartmoor are good examples in this country, and so are the high isolated masses like the Kollong rock in the Khasi Hills.

Thus, along the line (No. IV.) or the Himalayan axis, we frequently find the harder masses, of course on a gigantic scale, represented by the spurs connected with IV. N; these forming north and south lines of water-parting between great lateral valleys, with points on these spurs higher than anything else around them. So it follows that on one and the same line of elevation, we may have, and do find, sections like A, B, C, where Section B represents, diagrammatically, say at the Baralasa Pass, what I describe above. It is a very frequent feature, and one which has led to much discussion, as to which is the main range of the Himalaya. In Section C we suppose the primitive rocks to be softer than the stratified; so that, in the lapse of time since original elevation, the former have given way before the latter and the water-parting is on the subsidiary range. It is easy to understand that the elevation of this portion (IV. N) of the Himalaya is the result of the crushing forces between the two great main axis lines, No. III. and IV., adjacent to and between which the stratified rocks were originally deposited, and therefore it cannot be considered of so much importance, from a physical point of

view, as the two last-mentioned elevations. In the Padam, Section A, the stratified rocks are the most denuded, and the Himalayan water-parting is found on the axis of the deeper seated and metamorphic rocks.

In the Ladak range further north, No. III. (indicated in Section A), we have another example of an original line of elevation; for on the south are the early tertiary formations resting against it, forming a long narrow basin of these rocks, the southern boundary of which is not so clearly defined, being lost in the extreme crushing the beds have undergone, as is well seen on the road from the Indus to the Tsomorirhi Lake, producing, parallel to that river, the subsidiary line of elevation 4 N". These examples are sufficient, I trust, to show the weight I attach respectively to the broad and narrow red lines upon the map; the sub-Himalayan elevation being typical of that of the whole mass. By way of further illustration let us suppose that we are dealing with an elevation of stratified rocks alone, in the south-east of England (a much less disturbed or contorted area than the Himalayas), then, the centre of the Weald would represent a main axis lying on the strike of the oldest formations, whilst the run of the North and South Downs would represent the subsidiary axis lines, which although so much higher, and so much more conspicuous, are in fact lying on spurs connecting them with the central water-parting: this is the true orographical view of the area.

It is not, however, so easy to reconcile the many ideas on orography with geological reasoning, or to keep, at the same time, the features of the one subservient to the boundaries and foundations of the other; and this must be some excuse for entering into details so familiar to many. I desire only that this outline of main features should be useful; it is based mainly on physical structure noted in the field, not on a mere reference to the features as displayed on some maps, where, as is frequently the case, faulty compilation gives undue relief and importance to some ranges over others, an importance which, when compared with nature, they do not possess, thus engendering false conceptions of the whole. I leave it to future travellers and those who know the country to work out this subject yet further and with greater exactness, and after a closer examination of the country than I was ever able to give to it; and I leave it especially to those who may have the good fortune to visit the middle and eastern portions of the Himalayas and that great *terra incognita* beyond.

I have also indicated on the map by a fine dotted line the south and north Himalayan ranges of Mr. Trelawny Saunders and his Karakoram Gangri, which, on the whole, correspond respectively with the southern, central, and northern main ranges of Mr. Clements Markham. Starting from the west, the southern is shown as commencing near Dir in Chitral, and at Mozufferabad as joining the Kajrag, and thence following the Pir Panjal south of Kashmir, so far commencing from Mozufferabad: this is a portion of my "outer Himalaya." The direction of the

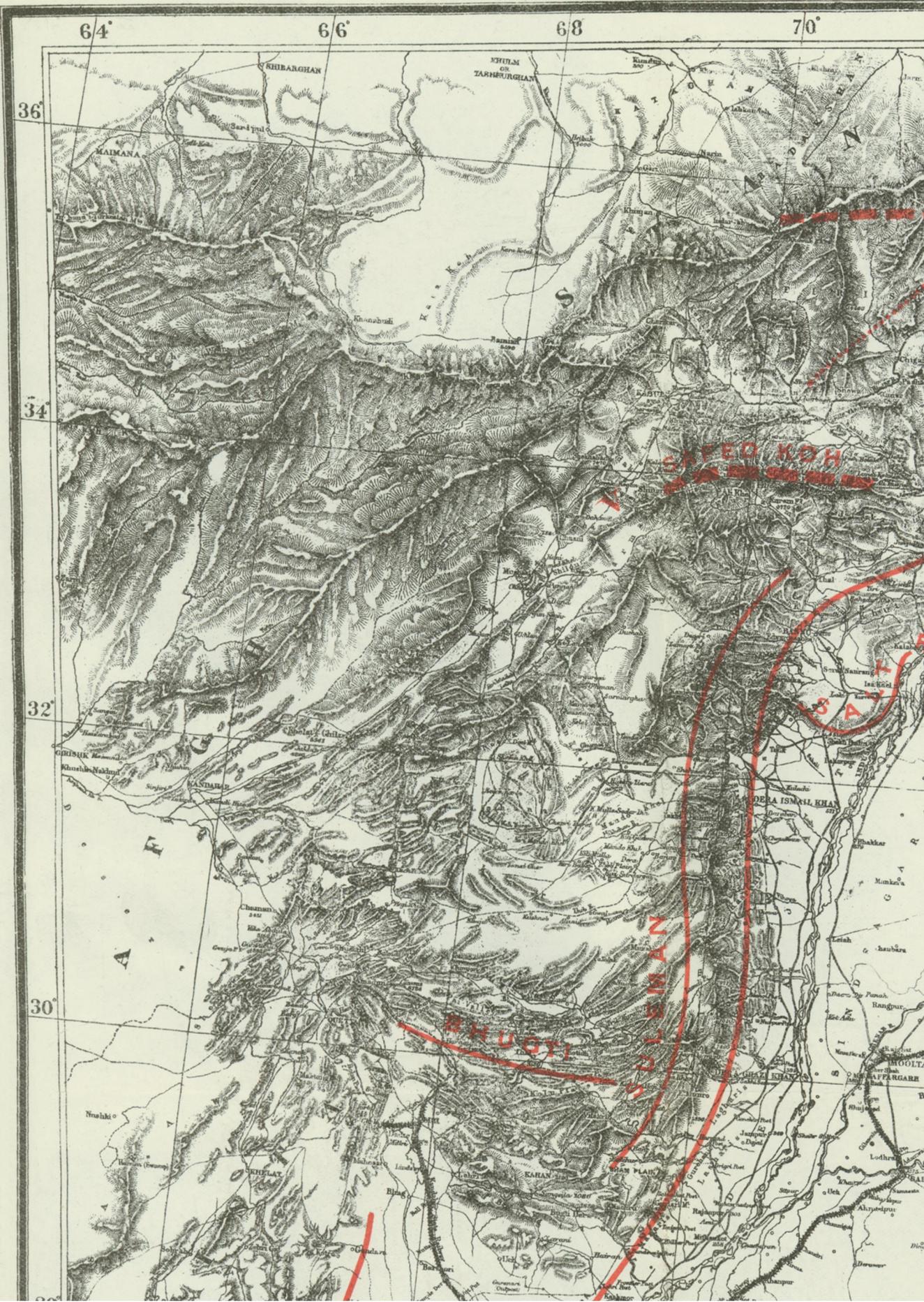
Zuzufzai Hills is, I think, much nearer its western extension. At the eastern end of the Pir Panjal, Mr. Saunders takes his range some distance back to the mountains skirting the Chandrabagha or Chinab, thus ignoring the true extension and high gneissic ridge of Chatadhar and Dhaoladhar which separates the mountain country of Kishtwar, Budrawar, and Chumba from the sub-Himalaya and the plains. His range is thence continued, easterly, on or close to my main Himalayan range. His northern range lies, also, in places, on this latter; commencing at the Nanga Purbet to the northern water-parting of Kashmir, it follows this exactly up to the high range south of Padam, the true Himalayan axis. East of Padam, again, the winding water-parting defines this range to the Manasarawar Lake, and further to the eastward it is carried parallel to the Sangpo, much further to the north. Mr. Saunders' Karakoram range eastward of the Mustakh conforms to the water-parting north of the Indus up to Rudok, where it is made to cross on to the Aling Gangrhi or my trans-Indus extension; it is then carried south to unite with the high range north of the Manasarawar Lake, and is there continued east as a range north of, and parallel with the Sangpo. It is unnecessary to define it further, for the topography does not exist from which we can lay down such lines; the same may be said of the Kuen Lun extension east of long. 80°.

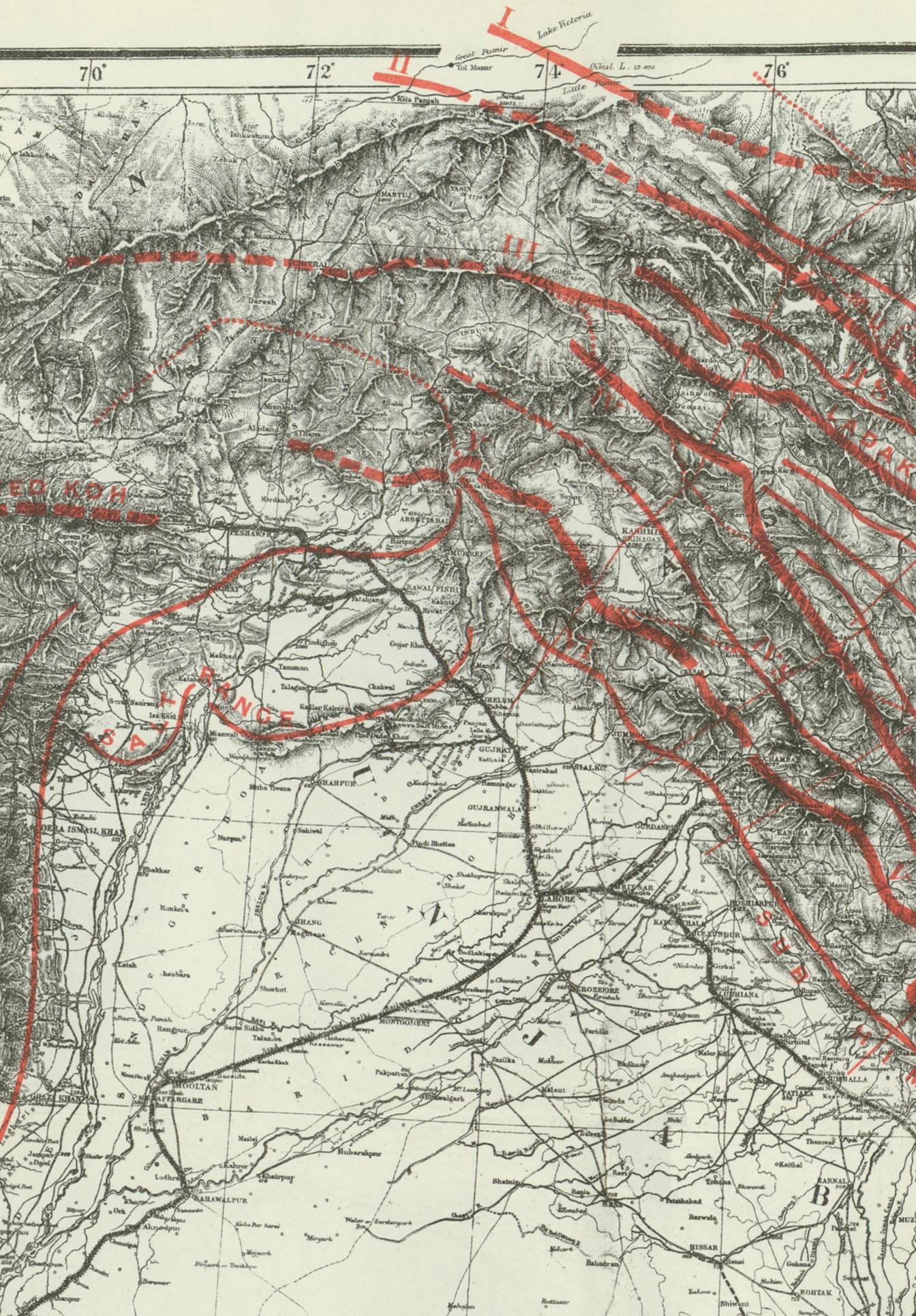
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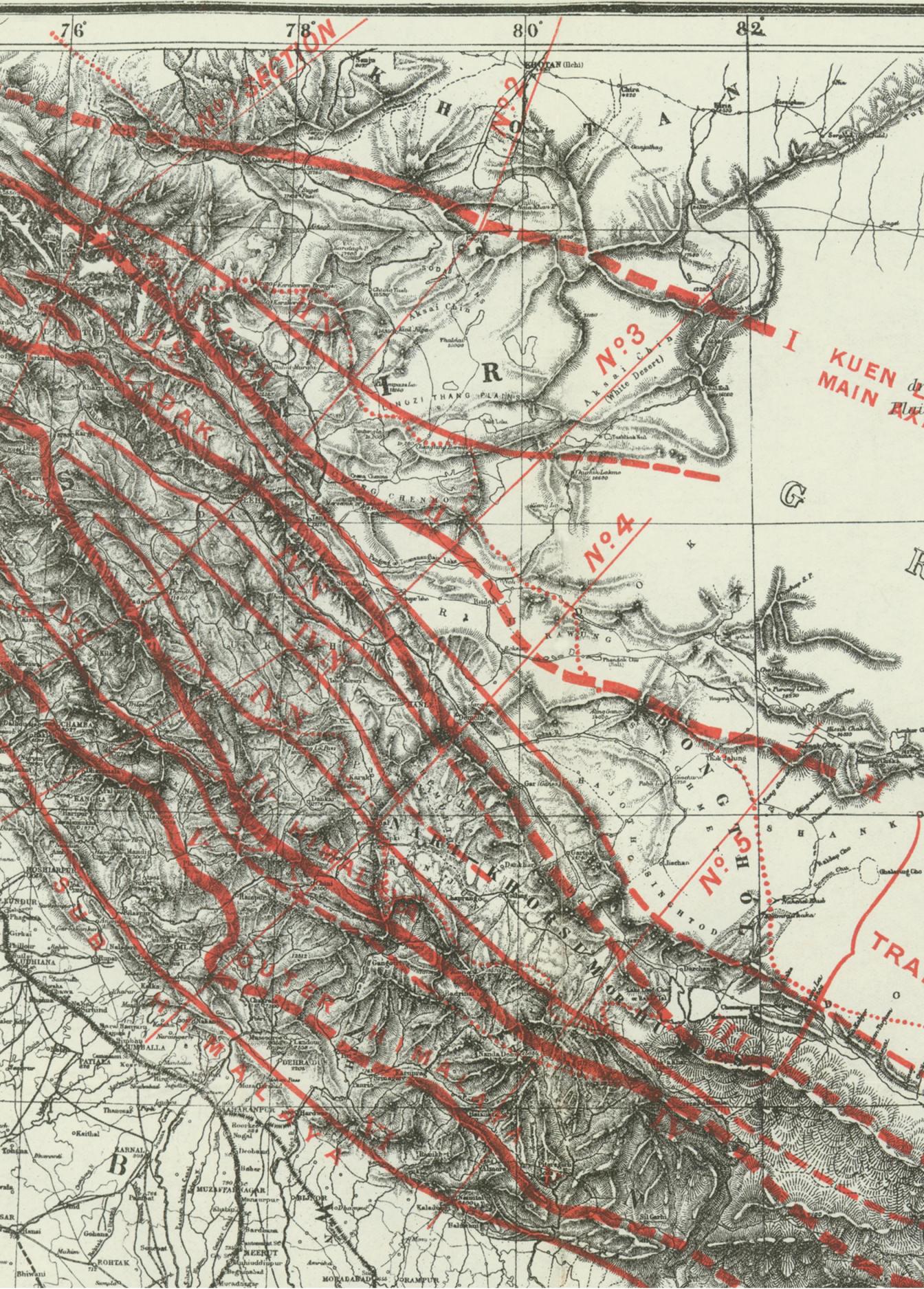
### GEOGRAPHICAL NOTES.

**Morrison's Expedition into the Interior of New Guinea.**—An exploring party, equipped by the *Melbourne Age*, under the command of Mr. George Ernest Morrison, started from Port Moresby soon after the return of the *Melbourne Argus* Expedition\* last autumn. Its object appears to have been similar, namely, to cross the island to the north-eastern coast, and it seems to have followed the same or nearly the same route as far as the foot of the Central Range, and to have been compelled, like its predecessor, to bend thence to the eastward in search of a place low enough to cross. Horses were taken, and plenty of pasture found up to the main watershed. At the foot of the range, however, when on the point of success, Morrison was attacked and severely wounded by the natives, who for many days had become increasingly menacing, and the party had to make a hurried return towards Port Moresby. In his telegram to the *Age* from Cooktown, Queensland, sent immediately on his arrival, November 20th, Morrison says he had reached a point more than 100 miles distant from Port Moresby, and was attacked whilst crossing a spur of the main range. His party was a very small one—two white men besides himself, only one of whom, Lyons, could be relied on, and apparently only two native porters.

\* Proceedings R. G. S., January number, *ante*, p. 37.



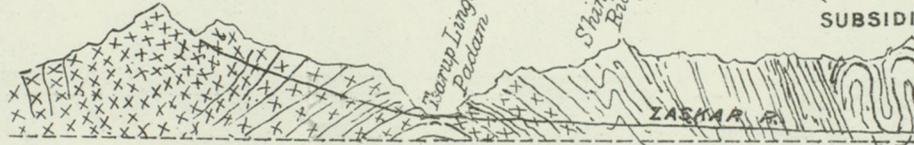




82° 84° 86° 88°

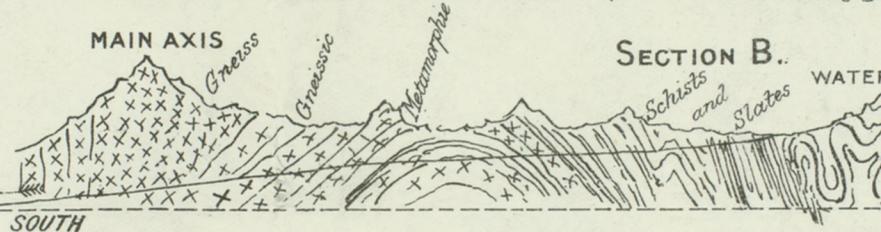
HIMALAYAN OR ZASKAR MAIN AXIS AND WATER PARTING

(Diagram SECTION A. (not drawn) SUBSID



MAIN AXIS

SECTION B.. WATER



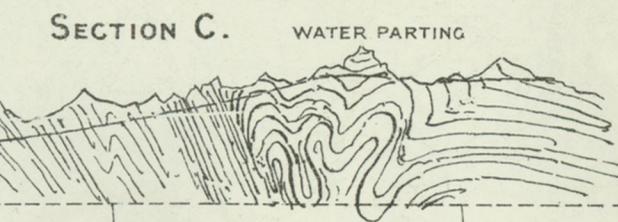
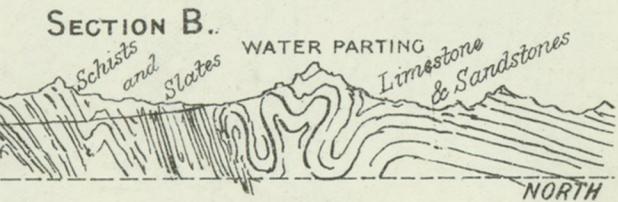
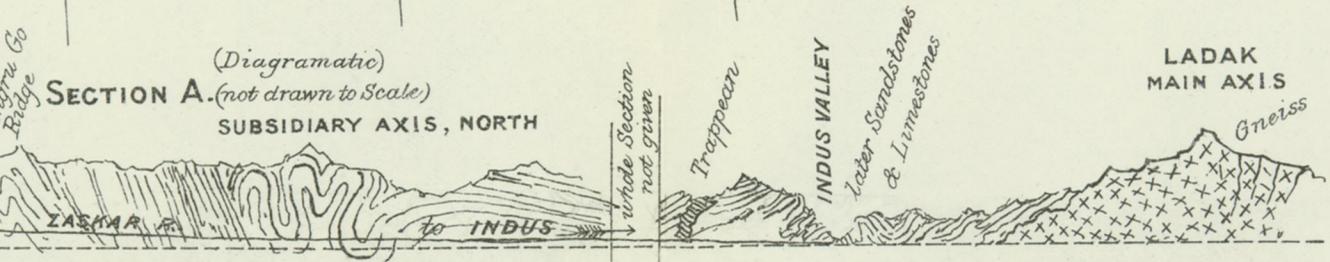
I KUEN LUN MAIN AXIS OR drainage to Plains of India

SECTION C. w

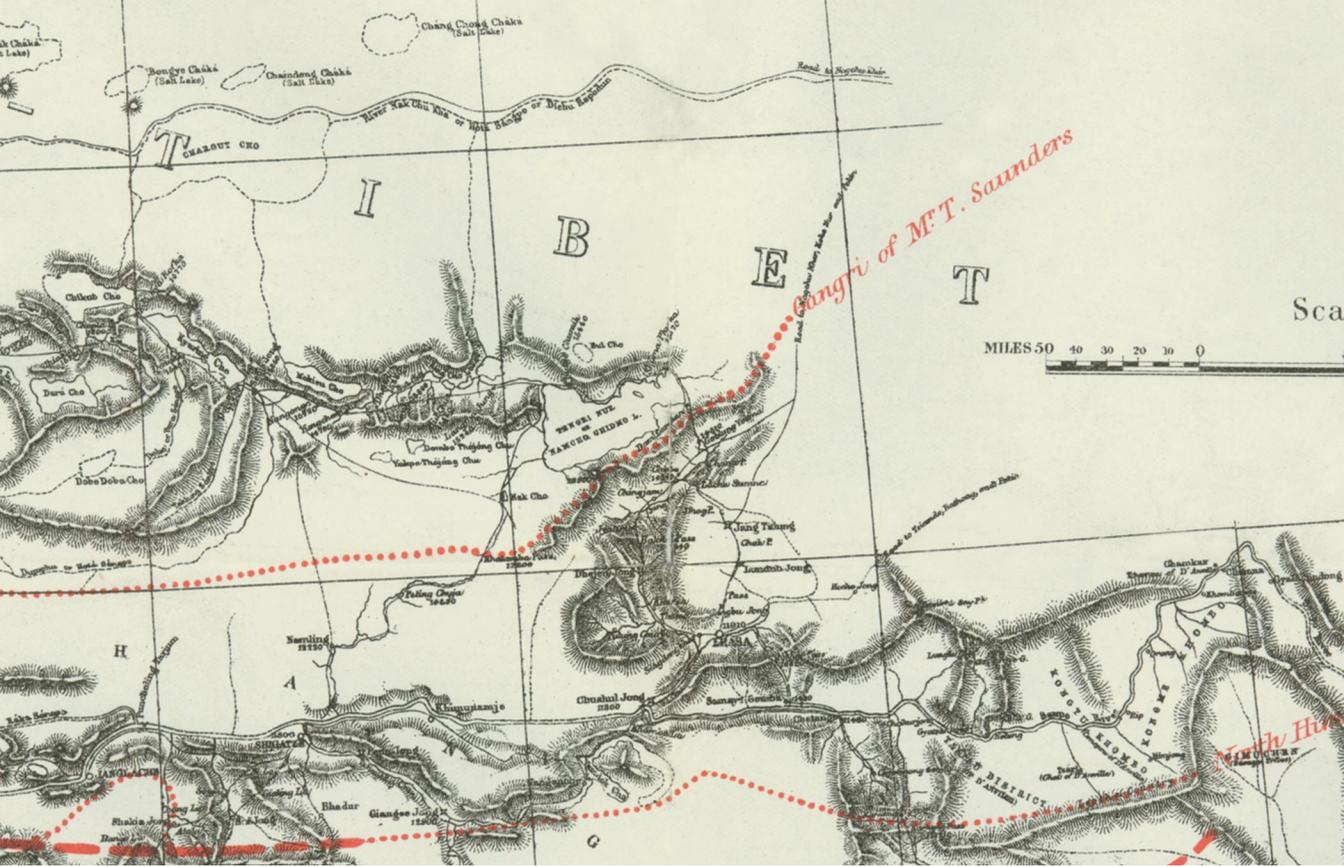
MAIN AXIS



88° 90° 92° 94°



An attempt to m  
 thus lead to the intro  
 To illustrate the address  
 port, 1883, by Lt.-Col. H  
 Reduced from th  
 direction of Lt.-Col. J. T



94° 96° 98° 100°

36°

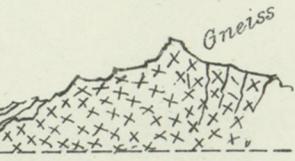
34°

32°

30°

28°

LADAK  
MAIN AXIS

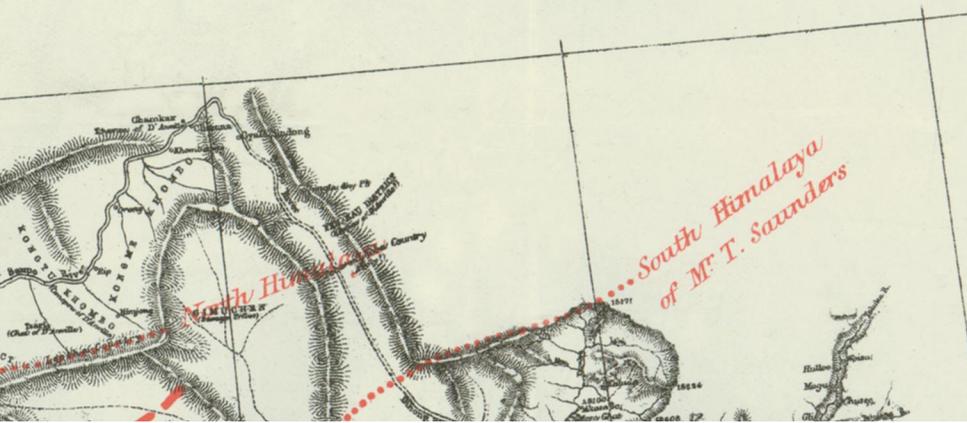
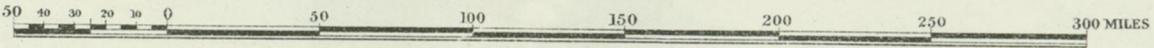


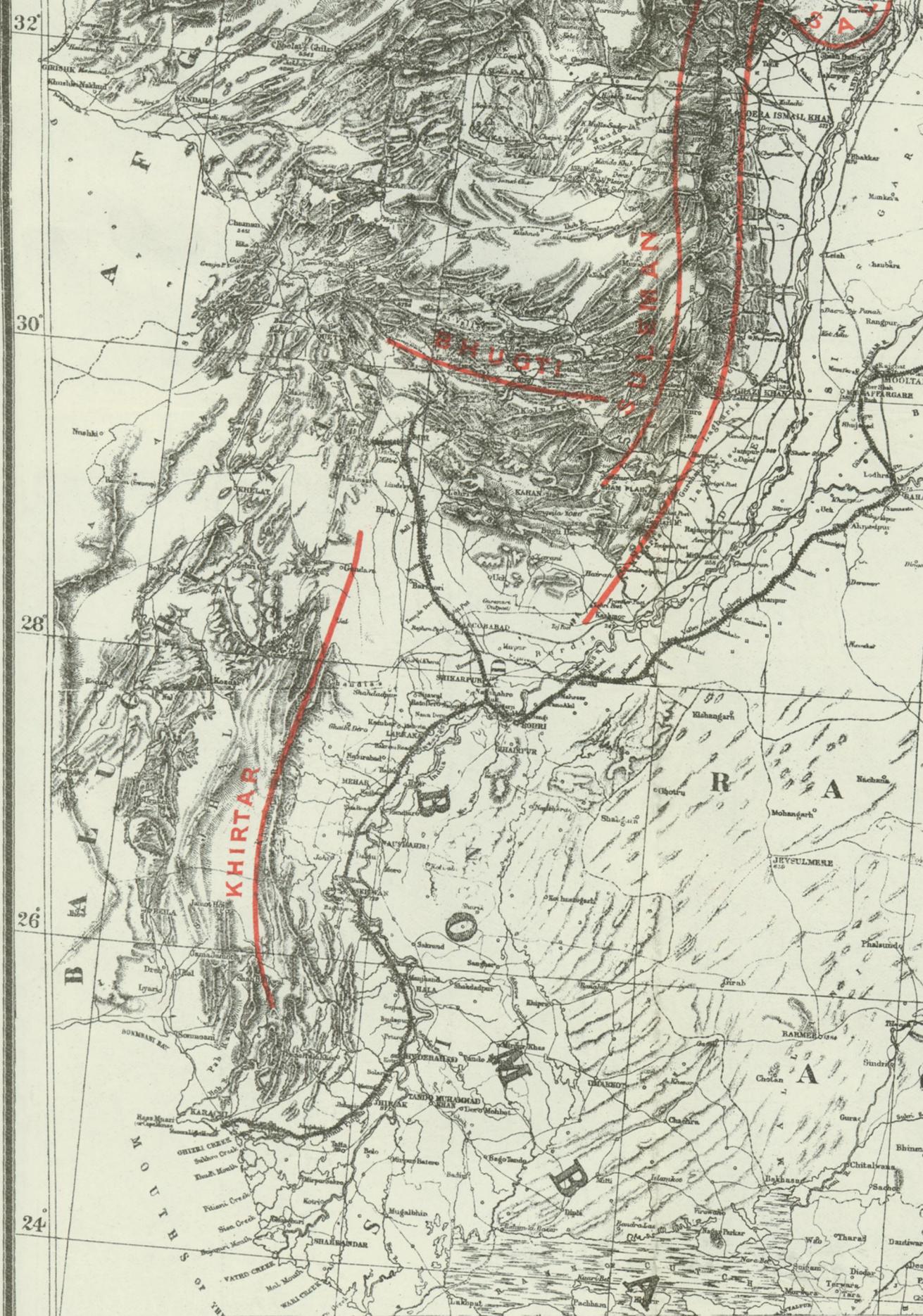
# THE MOUNTAIN SYSTEM OF THE HIMALAYA and neighbouring Ranges of INDIA.

An attempt to make the Orography more accordant with the Geological structure, and thus lead to the introduction and use of a common nomenclature in Geography and Geology. To illustrate the address to the Geographical Section of the British Association at Southport, 1883, by Lt.-Col. H. H. GODWIN-AUSTEN, F.R.S., F.R.G.S.

Reduced from the Railway Map of India, 1st January, 1882, published under the direction of Lt.-Col. J. T. WALKER, C.B., R.E., F.R.S., Surveyor General of India.

Scale 1 Inch = 64 Miles or  $\frac{1}{4,055,040}$





MACLURE & MACDONALD, LITHO TO THE QUEEN, LONDON.



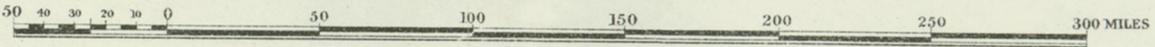






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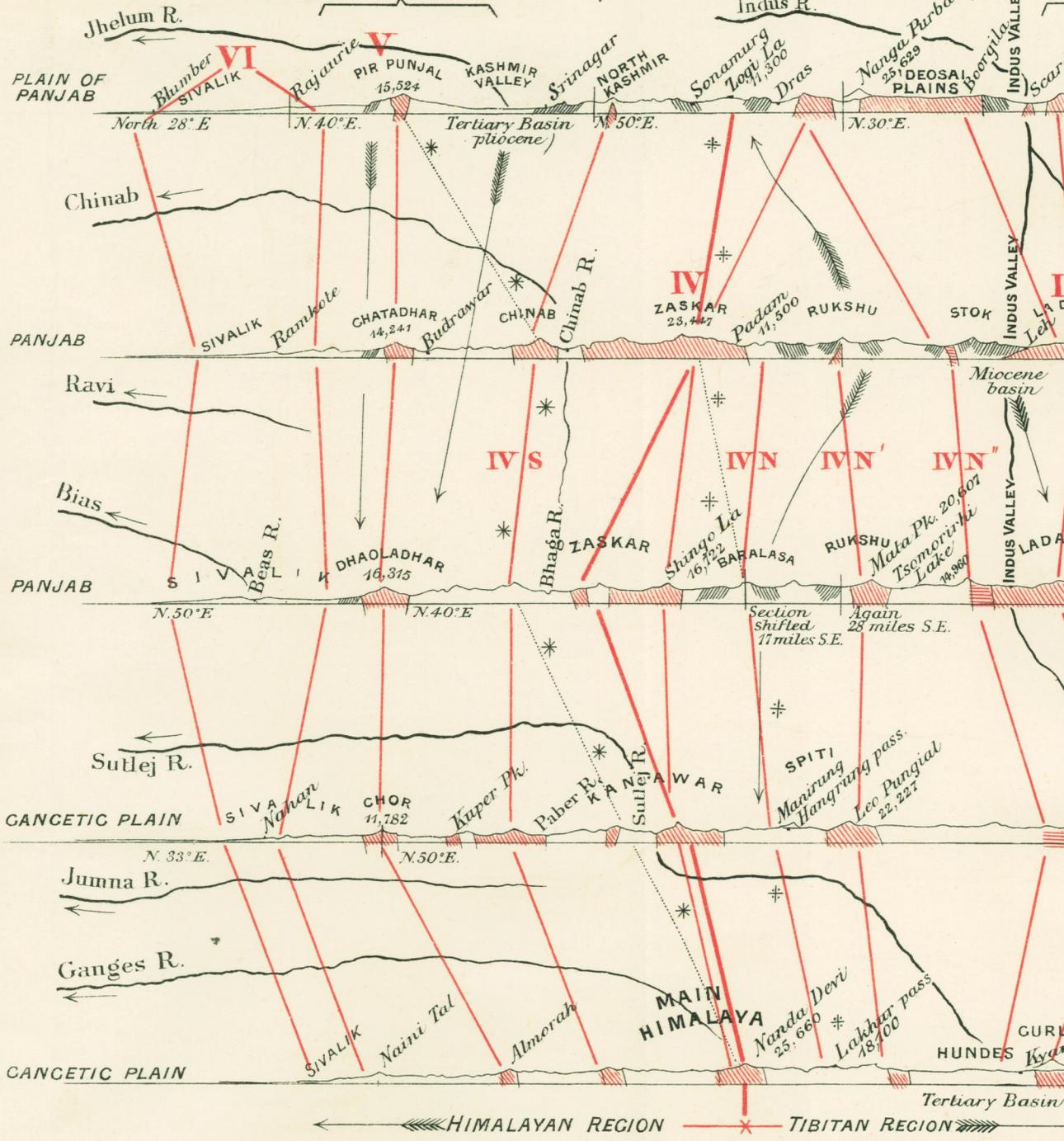
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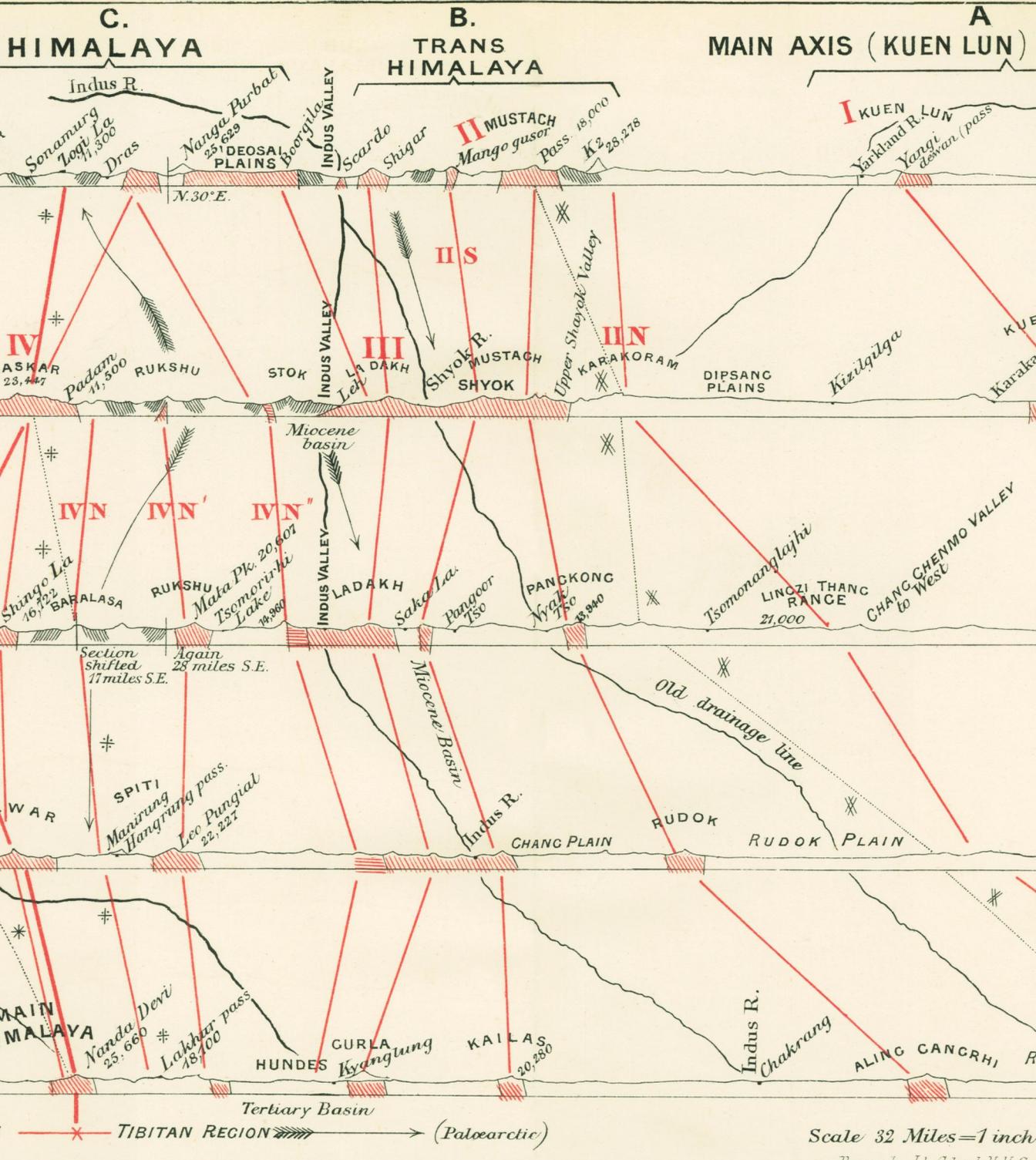
24

**E. SUB HIMALAYA      D. OUTER HIMALAYA      C. HIMALAYA**



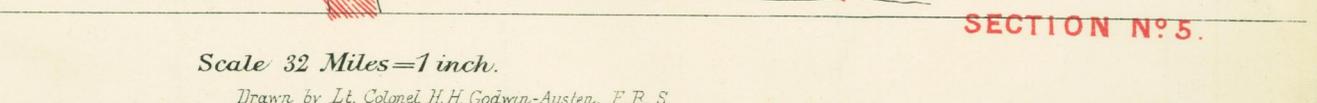
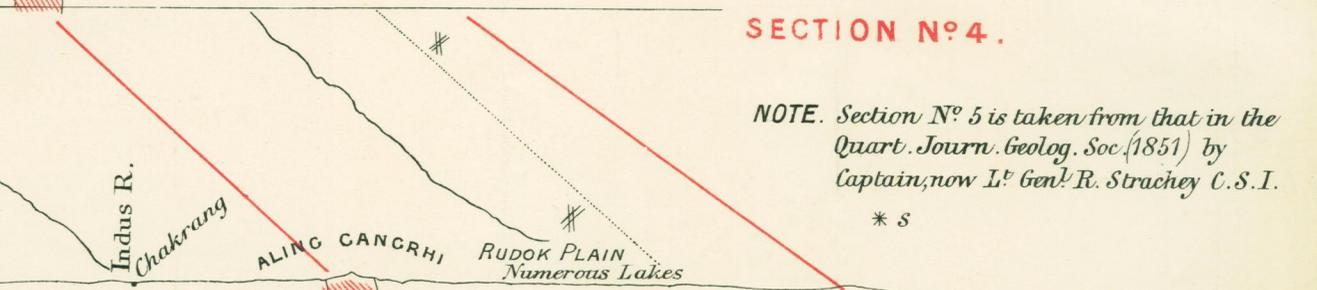
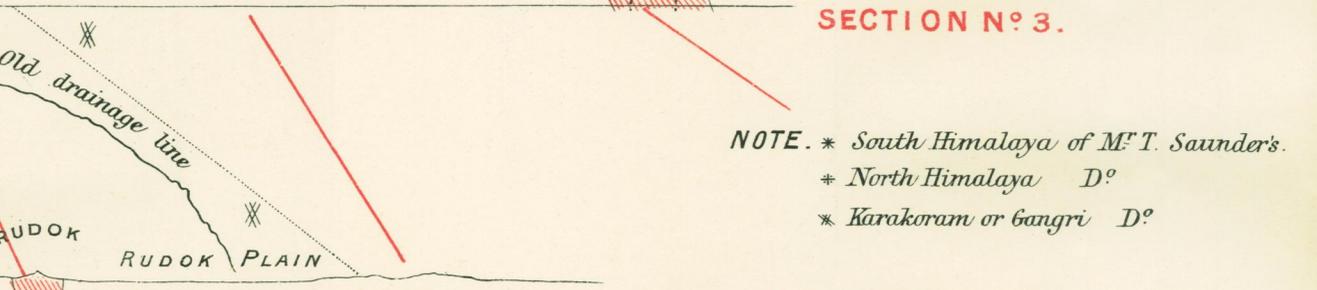
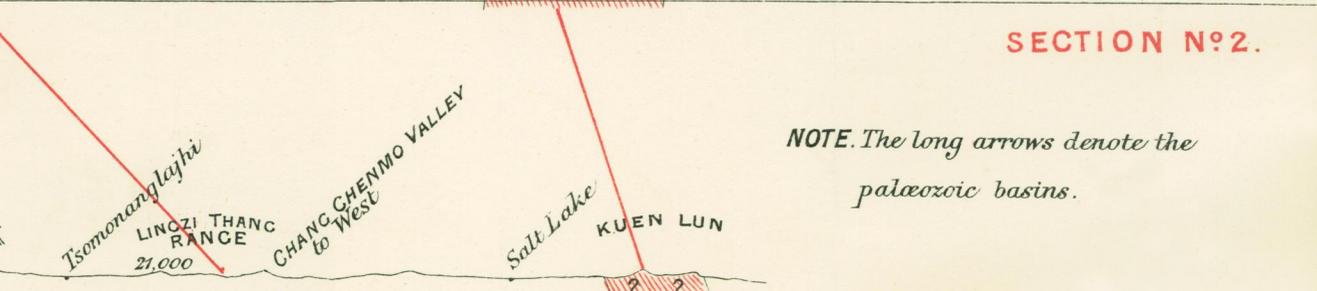
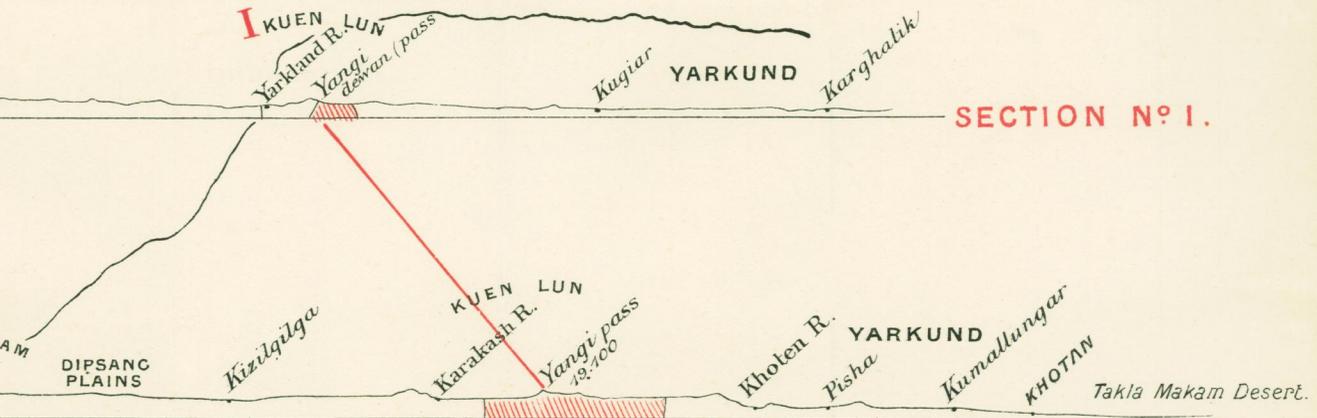
Published for the Proceedings of the Royal Geographical Society, 1884.

FIVE SECTIONS



# FIVE SECTIONS ACROSS THE HIMALAYA.

**A**  
**MAIN AXIS ( KUEN LUN ) OR CENTRAL ASIAN**



NOTE. The long arrows denote the palaeozoic basins.

NOTE. \* South Himalaya of M<sup>r</sup> T. Saunder's.  
 \* North Himalaya D°  
 \* Karakoram or Gangri D°

NOTE. Section N° 5 is taken from that in the Quart. Journ. Geolog. Soc. (1851) by Captain, now Lt Genl R. Strachey C. S. I.  
 \* s

Scale 32 Miles = 1 inch.  
 Drawn by Lt. Colonel H. H. Godwin-Austen, F. R. S.