

THE ICE-AGE ON THE TIBETAN PLATEAU AND IN THE ADJACENT REGIONS

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THE main aim of this paper is to give a general idea of the extension of the glaciers during the Ice-Age in Tibet and in the mountain ranges bordering that great plateau. I shall endeavour to give a comprehensive study, based upon numerous reports as well as upon my own explorations. In September 1929 I had the opportunity of examining the large collection of photographs stored in the map-room of the R.G.S. Amongst this collection there are many which, from a morphological point of view, are extremely interesting, and I shall have occasion to refer to a number of them later on.*

The territory to be considered in this paper includes the high mountain ranges of the Kunlun and the Karakoram, the big plateau of Tibet proper, and the Himalaya and Sino-Tibetan ranges. Before dealing with the special investigation of ancient glacial troughs and valleys, of moraine walls, striated boulders, trough-shoulders, and so on, I will summarize the main data at our disposal about the above-mentioned regions, beginning with the mountain ranges bordering the Tibetan plateau in the north.

1. *The Kunlun Ranges*

The geological and geomorphological exploration of this big system of mountain ranges has been much neglected. With the exception of Stoliczka† and Bogdanovich‡ no trained geologist had ever done any remarkable work there until my companion, Dr. de Terra, started with his geological work in the Western Kunlun in 1927-28.§ Collections of rock-specimens had been made by Zugmayer|| in the upper Keriya Darya district, and by Hedin¶ in the Kunlun ranges rising between the Lop Depression and the high plateaux of Tibet proper. But we need not be astonished if we do not get much information from these explorers about the extension of the glaciers during the Ice-Age in these regions. We find a hint about the former more extensive glaciation of the Arqa Tagh in Hedin's 'Scientific Results of a Journey in Central Asia,' vol. iii, p. 83, where he says, "The glacial mass that now survives rises therefore like an *insula-relicta*, a fragment of an immense ice-sheet that has now all but entirely disappeared."

Schlagintweit** had already mentioned that formerly the end of the Elchi glacier (on the northern side of the Hindutash Davan) was nearly 1700 feet lower than the spot where it ended when he saw it in 1856. But the best infor-

*I am very much obliged to Lt.-Col. Wood, Major Mason, and Dr. De Filippi for allowing me to reproduce here several of their photographs.

†'Scientific Results of the Second Yarkand Mission' (Calcutta, 1878), vol. i.

‡'Geological observations in Eastern Turkestan' (Russian). St. Petersburg, 1892.

§'Geologische Rundschau' (Berlin, 1929), Bd. XIX, pp. 41-51, Bd. XX, pp. 120-136.

||Ztschr. d. Deutschen Geologischen Gesellschaft, 1913, pp. 173 et seq.

¶Petermanns Mitt. Ergh. 131.

**Schlagintweit-Sakülünski, 'Reisen in Indien und Hochasien' (Jena, 1880), Bd. 4, p. 140.

mation about the former glaciation of the Kunlun we owe to Sir Aurel Stein,* G. Sobolevski,† and to G. Prinz.‡

Sir Aurel Stein, who visited the high alpine valleys of the Kunlun south of Khotan, refers to the big loess-covered moraine walls in the Nissa and Qaranghu Tagh district (10,000 feet). Sobolevski, who made his explorations in the westernmost Kunlun in 1913, calls special attention to terminal moraine deposits in the following valleys of the western Kunlun: in the Qaratash valley at 3500 m.; the Yeisa valley at 3500 m.; the Tarlung valley at 3300 m.; the Leisa valley at 3500 m.; the Paspu valley at 3000 m.; the Chong Karaz valley at 3700 m.; the Kilian valley at 3450 m.; and the Kichik Karaz valley at 3500 m.; the Tegerek valley at 4000 m.; G. Prinz, who also paid a visit to the western Kunlun, gives lower heights for old moraine deposits: in the Qaratash valley, 3100 m.; and in the Pittik, 3250 m.

He also paid special attention to the configuration of the valleys. Judging from the prevalence of the U-shaped sections of formerly glaciated valleys, he states that the glaciers ended in the Jainage-Korumdu valley at 2800 m.; the Ordolon valley at 3245 m.; the Chimgen Su valley at 3300 m.; the Pittik valley at 3250 m.; and the Otrake valley at 3400 m.

Sobolevski believes that during the Ice-Age the snow-line on the northern slopes of the Kunlun was at 4100–4150 m., on the southern slopes at 4500 m.; while the corresponding heights of the present snow-line may be taken as 4800 m. and 5160–5200 m. according to Sobolevski's and to my own observations. But as to the height of the Pleistocene snow-line, Prinz as well as I myself get lower values. My observations in the Kilian valley tend to show that during the biggest glaciation the glaciers in this valley also ended as low as 2800 m. There are two moraine deposits in the Kilian valley; the upper, also mentioned by Sobolevski, consists of big boulder deposits, while the lower is more difficult to trace, being covered by loess. But if the badly preserved lower deposits should give rise to any doubt as to their origin, the beautiful trough-shaped valley and the old trough shoulders prove the bigger extension of the glaciers down to this spot (Pl. 1). So I believe that Prinz is right in assuming a depression of the snow-line during the later glacial periods by at least 600 to 800 metres. As the main aim of this paper is to examine which parts of Central Asia were once buried under glaciers, I shall not discuss here the question of the existence of the different glacial periods, the more so as this question is still unsettled, although we can fairly safely assume that there were at least three greater glacial periods.

The data about the former glaciation of the Kunlun Ranges east of the meridian of Khotan are very scanty. As the present snow-line is, according to Pyevtsov,§ much higher there than in the west (northern slope 5400 m., southern slope 5700 m.), we can fairly safely assume that the same also applies to the snow-line during the glacial period.

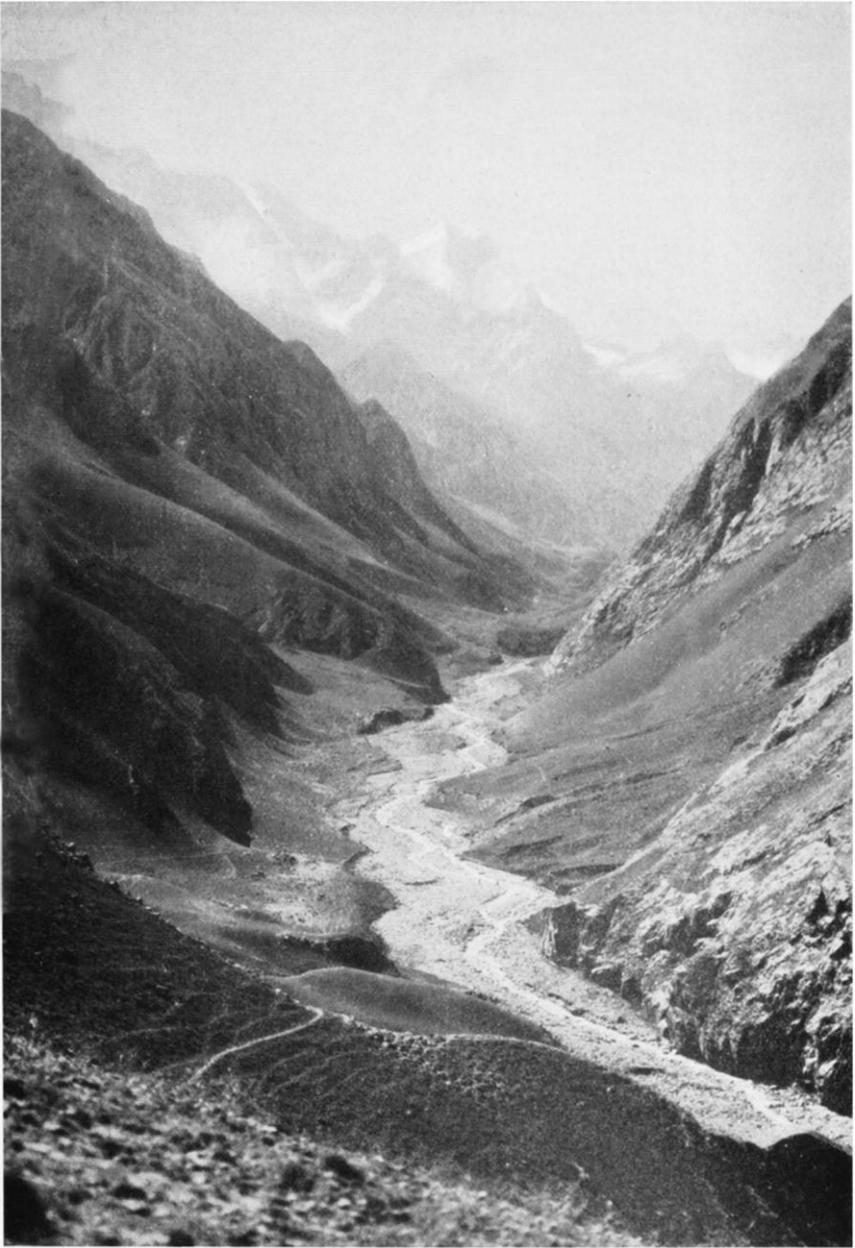
Some noteworthy observations about a former larger glaciation of some

*A. Stein, 'Ruins of Desert Cathay' (London, 1912), vol. i, pp. 182, 199.

†G. Sobolevski, 'The present and past glaciation of the western Kunlun,' *Bulletin Russian Geographical Society* (Petrograd, 1919), Bd. 54, p. 97.

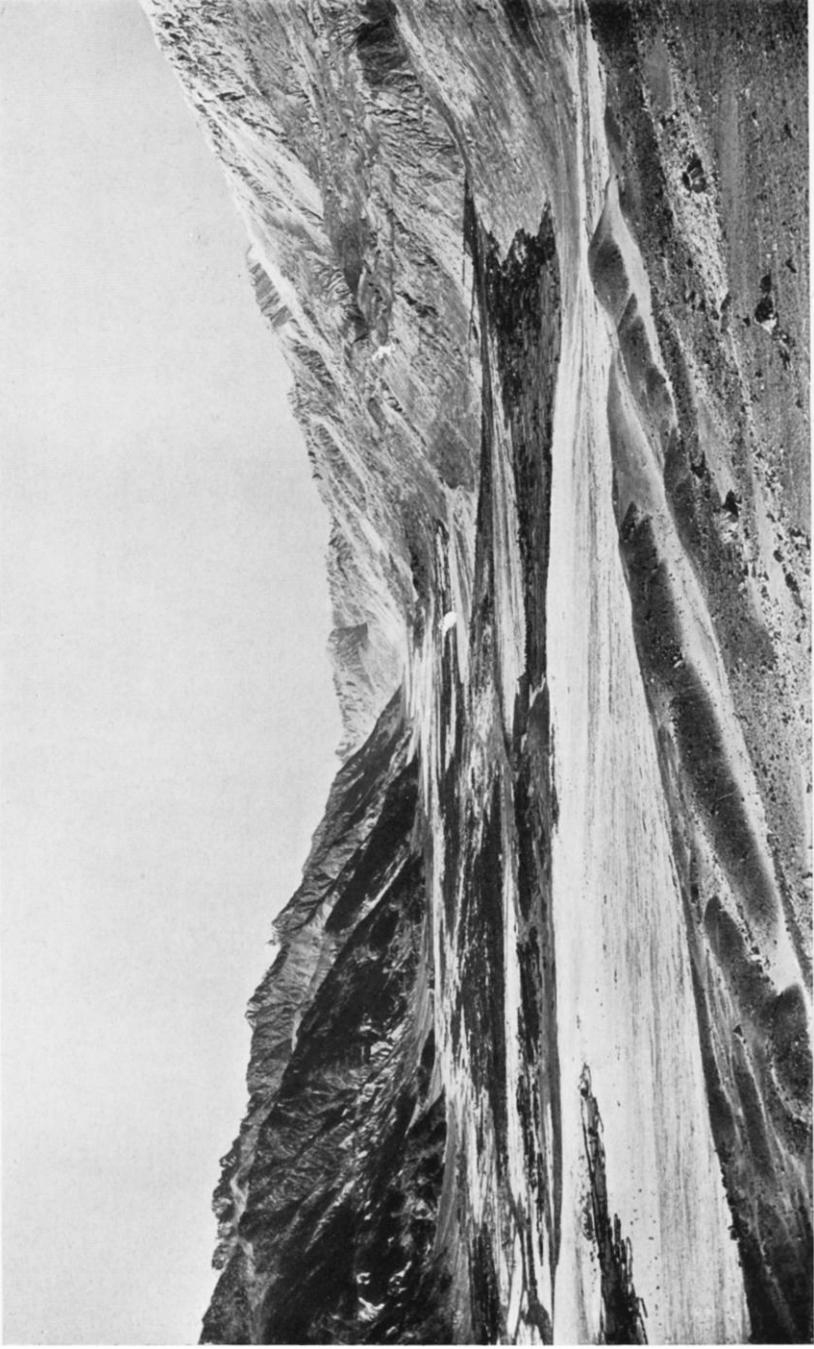
‡'Ergebnisse der Forschungsreisen durch Innerasien,' v. G. Prinz (Pécz, 1928).

§'Results of the Expedition to Tibet' (Russian), Petersburg, 1895, vol. i.



Phot. E. Trinkler

1. The glacial-troughed valley of the Upper Kilian Darya



Phot. K. Mason

2. Looking up the Nubra valley from near its junction with the Shyok

ranges in the eastern Kunlun were made by Albert Tafel.* He mentions cwms on the northern side of the Burkhan Buddha Range and erratic boulders. He also found moraine deposits in the Bayen-khara Mountains, where the valleys are often trough-shaped.

2. *The Karakoram*

Observations as to the former greater extension of glaciers are as numerous in the Karakoram Mountains as they are scanty in the Kunlun. G. Dainelli, who accompanied Dr. Filippo De Filippi's expedition to the Karakoram Mountains in 1913-14, has given us an excellent general review of all earlier notes on former glaciation in those regions, and he has corroborated these data with his own observations.† In his opinion there were four great glacial periods in this part of Central Asia, corresponding with the Mindel, Riss, Würm, and Post-Würm stages in the Alps. Unfortunately, the terminal moraines of the first two glaciations are so poor and so much obliterated that it is impossible to give an approximate height for the snow-line during those periods. But it is absolutely certain that big glacial-troughed valleys had already been modelled and excavated by more ancient and bigger glaciers, before the terminal moraines of the third glaciation were deposited. Dainelli believes that during the earlier glacial periods the big Indus Glacier ended with its snout in the lake formerly covering the Punjab between the foot of the Western Himalaya and the Salt Range. We now have fairly abundant material at our disposal in order to get an idea of the extension of the glaciers during the later glacial periods. Nearly everywhere in the region of the Karakoram-Himalaya, terminal moraine walls near the debouchure of tributary valleys into main valleys (Shyok-Indus-Nubra-Hunza valley) prove that the glaciers advanced considerably, often into the main valleys which had received their trough form during the earlier glacial periods. Dainelli has given a complete list of the moraine deposits of his third and fourth glacial periods, and he also discusses the elevation of the snow-line. His investigations show that during his third glacial period the height of the snow-line in the region of the Shyok valley must have been something like 5100 m., while during the fourth glacial period it was 5950 m. On p. 609 of his work he gives a sketch-map showing the height of the snow-line during the third period in the north-western Karakoram-Himalaya.

In 1926 Major Kenneth Mason passed the Nubra Valley on his way to the Shakgam, and in his report he† points out: "The whole valley at one time must have been filled by a huge glacier nearly 100 miles long which pushed its snout across the valley of the Shyok, damming back that great river and causing an immense lake to form behind it. Longstaff, who in 1909 passed up the Nubra by the right bank, remarks that the solid rock near the junction is for hundreds of feet above the river-level polished, rounded and scratched by the ancient glacier. For my mind there is no doubt about the existence of this glacier, for I could still observe the remains of old lateral moraines first noted by Drew high up the mountain sides though they have been much eroded since his day."

Amongst the photographs taken by Mason there is one panoramic view of

**Ztschr. Ges. Erdkunde* (Berlin, 1908), p. 389.

†G. Dainelli, 'Studi sul Glaciale' (Bologna), 2 vols.

‡'Records of the Survey of India' (Dehra Dun, 1928), vol. xxii, p. 14.

the Nubra valley showing its glaciated form quite well (Pl. 2). I myself paid a visit to the Nubra valley in autumn 1928. I studied the beautifully striated rocks and boulders between Panamik and Sumur, and I found terminal moraines near Thirit and Khalsar in the Upper Shyok valley. A photograph taken by F. O. Cave on Mason's expedition to the Shaksgam shows the trough-form of the valley called B. Another very remarkable valley of this kind is Wood's valley I, called Lungmo-che by Mason. This valley is a typical broad trough with big névé reservoirs or cwms hanging over the valley* (Pl. 3).

Big glaciers pushed their snouts into the Qarakash valley from the great range in which the Suget Davan is situated. The moraine deposits between Suget-Qaraul and the Suget Pass prove that a glacier once ended there. There are two valleys uniting at approximately 4200 m.: both are broad U-shaped valleys, filled with detritus and gravels. If the big moraine deposits at the lower end of this valley were not proof that once a glacier really came down through it, it would hardly be possible for anyone to prove this fact by the morphological configuration of the upper part of the valley (Pl. 5). We shall see later on that the same applies to the valleys and plateaux of Tibet proper. There are valleys which were glaciated during the Glacial Period, but which have not the form of a glacial trough at all. But careful investigation will nearly always prove that along the slopes of the mountains bordering these valleys there are small rounded shoulders and remnants of old valley-bottoms, though generally so much worn and eroded that only a very careful observer can recognize them. Furthermore, in the more continental regions the valleys are buried under gravels and detritus, often hiding the lower part of the glacial-troughed valleys.

Another valley which once contained a big glacier is that of the Upper Yarkand near Khufelang. Two photos taken by Wood prove this (see Pl. 4). Unfortunately, the material I have at my disposal concerning the Yarkand valley from Khufelang via Kulanuldi into the Raskam Valley is so poor that I am unable to estimate the former glaciation of that part of the valley. The big broad trough-like valley bordering the range in which the Karakoram Pass is situated in the south was formerly also glaciated, as prove its rounded and smoothed step-like shoulders (Pl. 6).

We have now to consider the regions lying farther west. The best idea of the former greater glaciation can be obtained from the region of the Hunza river. Conway in 1892 had already seen the "roches moutonnées" near Tashot.† The beautiful trough of the Hunza valley shows the action of the glaciers of the Ice-Age remarkably well. The eastern end of the Oprang Pass seems to be a broad U-shaped valley like the valley leading to the Mintaka Pass from the Chinese side. Arved Schultz states that once a big glacier coming from the Oprang and Hunserab region and uniting with the upper Taghdumbash Glacier pushed its snout into the Taghdumbash valley.‡ A photograph taken near Khaibar in the Upper Hunza Valley shows evidence of former glacial action, as does a photograph taken by W. R. Read from the Batura

*Wood, 'Explorations in the Eastern Karakoram and the Upper Yarkand valley.' Published by Survey of India (Dehra Dun, 1922), with photographs and map.

†Martin Conway, 'Climbing in the Himalayas' (London, 1894), p. 236.

‡Arved Schultz, 'Landeskundliche Forschungen im Pamir' (Hamburg, 1917).



Phot. H. Wood

3. *View north-east and east from peak 18,508 in valley I, Karakoram*



Phot. H. Wood

4. *Valley near Khufelang (Upper Yarkand valley)*



Phot. F. De Filippi

5. Formerly glaciated valley leading north from Suget Pass

Glacier looking up the Kanjut valley, and one by C. J. Morris at the junction of the Khunjerab and Ghujerab.* Nearly every photograph taken in the neighbourhood of the Rakaposhi gives an idea of the great effect of glacial action in these regions.

Farther west we come to the tributaries of the Hunza river, the Ashkuman-Karambar, with its right-hand tributary the Yasin. There are several very remarkable photographs in Stein's 'Innermost Asia.' I refer here only to figs. 38 and 41 (Head of the Yasin valley), and fig. 50 (Karambar valley). In 'Serindia,' vol. i, by the same author, there are two photographs giving a fine idea of the former extension of the glaciers in this region. No. 17 shows the Defile of Darband, with a view down to Jhopu in the Yarkhun valley, while No. 20 gives an idea of the Darkot Glacier from the foot of Raukang Spur, looking south. I have not succeeded in finding much material about the Yarkhun valley. A large photograph in the R.G.S. collection, taken by Captain J. Sulley, represents a view of Lower Kala Drosh in winter. The old rounded shoulders on the slopes of the mountains bordering the broad U-shaped valley are probably due to former glacial action.

We turn now to the region round Nanga Parbat. The only definite proofs of ancient moraines were found near Astor. Dainelli refers to these deposits† and points out that the end moraines near Astor, at 1300 m., belong to the third glacial period, while those near Rattu Spur in Astor Valley, at 2500 m., belong to the fourth. But during the older glacial periods the whole region must have been buried under ice. The valleys in the Darel and Chilas District have probably been modelled by former glacial action (see A. Stein, 'Innermost Asia,' vol. i, phot. 3, 16, 17, 18). Data about the difficult tracts east and west of the Indus Gorge below Bunji, however, are so poor that we cannot get any idea at all about the former extension of the glaciers there. The same applies to the lower Chitral-Kunar River running into the Kabul near Jalalabad, but that the upper Swat Valley once contained a glacier is evident from a photograph taken by Sir Aurel Stein.‡

3. Tibet

Before entering into the discussion of my own explorations, I will summarize the views of different explorers who have been in Tibet. Although Sven Hedin discussed in his older reports§ the probable glacial origin of several of the Tibetan lakes he says in his 'Southern Tibet,' vol. ii, p. 178: "On the highland Plateau of Tibet the temperature must have been sufficiently low to allow the entrance of an ice-age but even then and on account of the protection of the southern mountain systems the precipitation has not been sufficient to cover the highland with a cap of ice. There are glaciers, although sporadic, rare, and small, all over Tibet, and they advanced considerably at the same time as those of Himalaya and Kara-korum. But otherwise I have in vain searched for any traces of an ice-age in the country."

In his 'Transhimalaya' Hedin pointed out that the depressions of the Holy

*G. J., vol. 71, 1928, Plate facing p. 525.

†G. Dainelli, 'Studi sul Glaziale' (Bologna), vol. i, pp. 600, 604.

‡'On Alexander's track to the Indus' (London, 1929), Phot. 60: View down the Swat River from Peshmal.

§Sven Hedin, 'Scientific results of a Journey in Central Asia, 1899-1902' (Stockholm, 1904-1907).

Lakes (Manasarowar and Rakas Lake) were excavated by glaciers advancing from the range in the south.* Formerly he mentioned that probably the Naktsang Tso and the basin of the Ziling Tso were affected by glacial action. A study of the photographs published by Hedin leads us to the conclusion that the glaciers of the "Transhimalaya" also must have been longer; e.g. the photographs of the beautiful hanging valley in which nestles the monastery of Linga Gompa, and the Targo Kangri Range (south of Tangra Tso) wherein fine cwms can be recognized.† Hayden discovered ancient moraines on the shores of the Kyaring Tso; they can only have been deposited by glaciers coming down from the Transhimalaya in the south.‡ Huntington has published a special study of the glacial origin of Pangong Tso,§ and Dainelli also refers to the glacial origin of its basin. I think there can be no question about the basin of Pangong Tso having once contained a big glacier. The whole fjord-like valley containing the lake is a typical submerged broad trough (Pl. 7).

In 1846 Henry and Richard Strachey travelled in the district of the Holy Lakes, and Richard Strachey discovered unmistakable moraines in the Darma Yankti and in the Gunda Yankti valley.||

Hugh Rutledge has published a remarkable paper on a visit to Western Tibet in 1926.¶ Amongst the photographs reproduced there is a view of the Darma Gorge from near Nangling. The cross-section of the valley shows a trough-like form, indicating that glacial action has been active here. Amongst the collection of photographs at the R.G.S. there is another taken by Rutledge showing the view from the Lipu Lelch Pass towards the north. The valley down is trough-shaped. In the distance Gurla Mandhata with its big snow reservoirs can be recognized.

Very important observations about the former glaciation on the northern side of the Himalaya were made by members of the Mount Everest Expeditions. Heron, the geologist of the first Everest Expedition, says:** "I am able to add my testimony to that of Hooker, Blanford, Hayden, Garwood, and others concerning the former much greater extension of glaciation. The present glaciers are but tiny representatives of their former might as shown by the huge moraines which encumber all the northern valleys."

Also N. E. Odell, in his final report on the rocks and glaciers of Mount Everest,†† refers to the former greater extension of the glaciers. About the former glaciation of the northern side of the Himalayas he says: "Now, if we consider, in the light of such morainic evidence as remains, what effect on the country of the maximum phase of the Cycle must have meant, we must conclude that the ice completely blocked most of the valleys, and in fact that in many instances the ice streams were linked up on this north side of the main chain." Odell even

*Sven Hedin, 'Transhimalaya' (German Ed.), vol. ii, p. 107.

†Sven Hedin, 'Southern Tibet' (Stockholm), vol. iii, third plate after pp. 274, 280.

‡H. H. Hayden and Cosson, 'Sport and travel on the Highlands of Tibet' (London, 1927), p. 135.

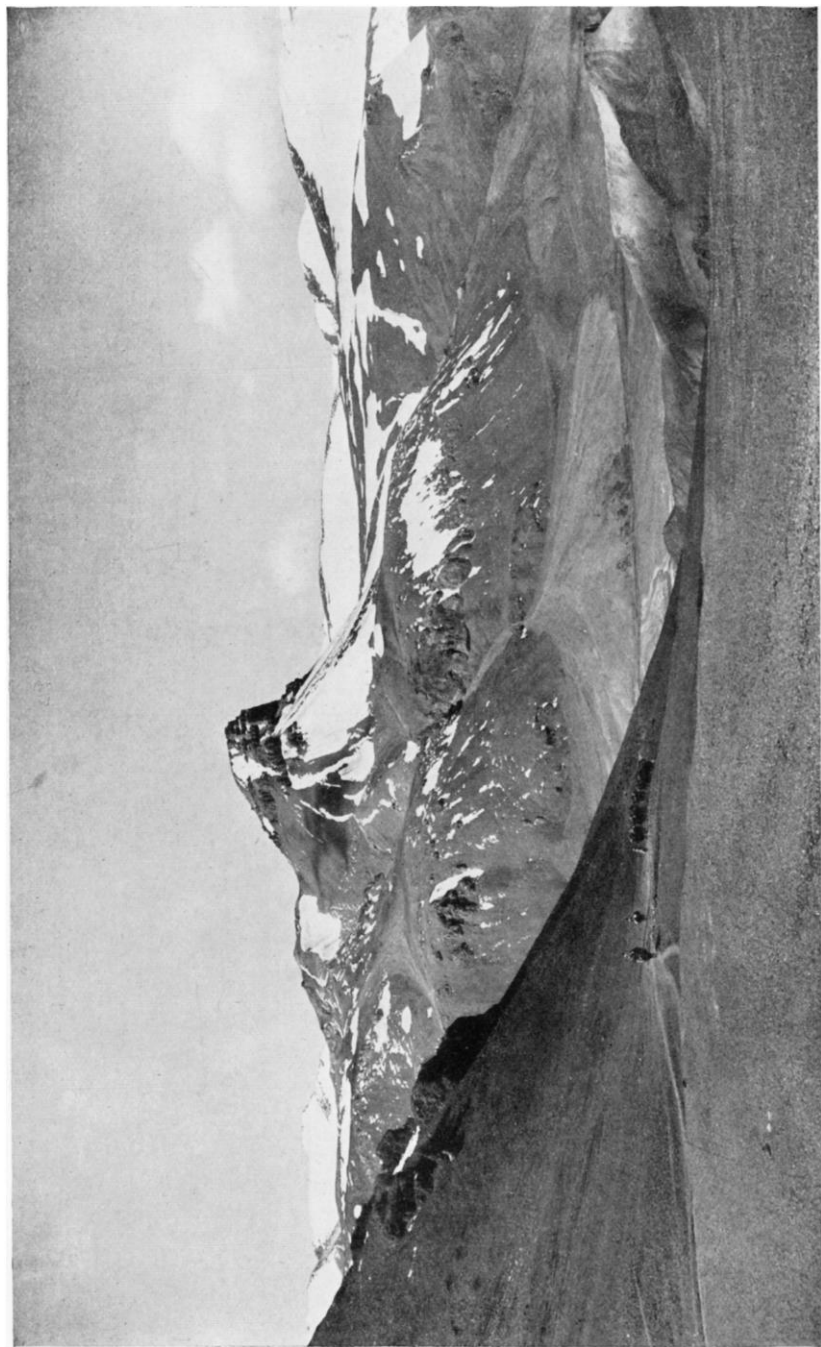
§Ellsworth Huntington, "Pangong, a glacial lake in the Tibetan Plateau," *Journal of Geology* (Chicago, 1906), vol. xiv.

¶*G. J.*, vol. 15, pp. 150 *et seq.*

¶¶*G. J.*, vol. 71, May 1928.

**'Records Geological Survey of India' (Calcutta, 1922-23), Part 2, LIV.

††*G. J.*, vol. 66, October 1925.



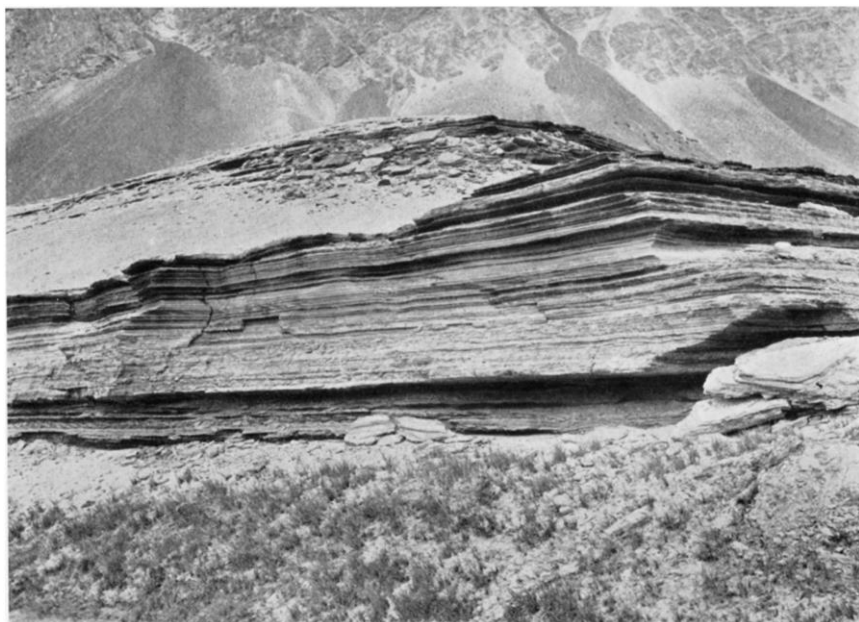
Phot. F. De Filippi

6. Glacial-troughed valley south of Karakoram Pass



Phot. W. Bosshard

7. Snow reservoirs in range south of Pangong lake



Phot. W. Bosshard

8. Stratified clay deposits of Pangong lake

refers to the possibility that many other parts of the Tibetan Plateau were engulfed by ice. For my part I even venture to say that very probably the Tsangpo valley also once contained a glacier, like the Upper Indus valley in the west. The basin of the Yamdrok Tso was deeply affected by glacial action; the bays and arms of this lake can easily be interpreted as submerged troughs.* Very similar cross-sections showing preserved valley bottoms and trough shoulders can be recognized in photographs taken in the Tsangpo valley. But here the greatest part of the broad trough is submerged and buried beneath fans of sediment and gravel deposits.

As to the former glaciation of the northern side of the Himalaya, the late Sir H. H. Hayden pointed out that the glaciers of Pauhunri and Kangchenjau once extended to the north into the Yaru plain and he also calls attention to the big moraine deposits of the Phari and Tuna plain. He says:† “The small glaciers on the northern sides of these mountains are but the shrunken relics of what must once have been a great ice sheet almost completely covering the slopes of the culminating range of the Himalaya and extending far into the neighbouring plains and valleys.”

Before entering into the discussion of the former glaciation of Central Tibet I have to point out here some features in the configuration of the valleys and plains on the Tibetan Plateau. An expert trained in glacial-morphological studies might be surprised to learn that the valley reproduced on Pl. 5 once contained a big glacier entering the Qarakash valley from the south. The same expert would probably deny the existence of a glacier when studying the photographs published in Hedin's ‘Southern Tibet,’ vol. iv, pp. 6 *et seq.*, showing the scenery round Marsimik Pass. But the extensive and well-preserved moraine deposits near Suget Qaraul as well as those near Pobrang, the hanging valleys on both sides of the valley leading to the Marsimik and Suget passes, and the small badly preserved shoulders on the slopes of the mountains, are proofs of the former glaciation. Several explorers have studied the Deosai plateau in Kashmir, and they have proved that during the Glacial Period this plateau was glaciated. The rocks are denuded and rounded, and the type of landscape is very similar to that in the mountains of Central Tibet and of the Transhimalaya, only that in these regions the rock is much more disintegrated (compare fig. i, Pl. 33, 34, Oestreich, “Die Täler des nordwestlichen Himalaya,” *Petermanns Mitt.*, *Erg.* 155, with plates following p. 278, Hedin, ‘Southern Tibet,’ iii).

In the continental regions of Central Tibet we scarcely ever find any striated boulders or polished rocks because the disintegration is too great owing to the strong insolation. We do not find any typical trough-like valleys because the pre-glacial erosion and dissection did not affect the Central Tibetan landscape so much as that of the bordering regions and because the valleys are now more or less filled up with younger deposits. The valleys are broad plains filled with detritus, sands and gravels. Like a big mantle the sheets of ice engulf the mountains.‡ Often the broad snouts of the glaciers enter the main valley

*See Phot. of Yamdrok Tso in ‘Tibet,’ by W. F. Ottley.

†‘Memoir Geological Survey India,’ vol. 36 (1907), Part 2, p. 15.

‡See *G. J.*, April 1927, Pl. 13, “Aghil-Depsang and Tatar-la”; Hedin, ‘Scientific Results,’ etc., vol. iii, Pl. 83; vol. iv, Pl. 73; H. H. P. Deasy, ‘In Tibet and Chinese Turkestan’ (London, 1901), plate on p. 85; and *G. J.*, vol. 16, 1900, p. 509.

plain. During the Glacial Period these glaciers must have united and they must have more or less filled the broad valley-plains. They did not wend their way through deeply eroded valleys and model them into steep-sided troughs, but the glaciers probably covered the plain-like valleys as well as the big plateaux in the shape of broad sheets of ice. Prinz has recently pointed out (p. 298) that during the Ice Age the ice covering the Eastern Pamirs was developed in the form of "Highland Ice" (Tafeleis), which does not leave any traces after melting. In my opinion the same may apply to the ice-masses which formerly covered the big valley-plains of North-Western Tibet. Recently Foster Flint has contributed remarkable observations and views about the stagnation and dissipation of the last ice-sheet of New England, in a well-illustrated article.* Considering the morphology of New England he describes the dissipation of the ice as a dead or stagnant mass resulting from total loss of forward motion. It is very likely that the same kind of dissipation took place when the glaciers of the Ice Age on the Tibetan plateau were melting. Flint has called special attention to the fact that the rate of melting is a variable factor which depends upon the different degree of exposure of rock-slopes and ice. The rate of melting is controlled by topography, for in the neighbourhood of mountains and nunataks the ice will melt rather quickly and marginal lakes are formed. The more the ice is melting the more water covers the plains and valleys, especially in regions which have no outlet. Many of the big broad valleys on the Tibetan plateau were once transformed into lakes, which afterwards shrank more and more, till nothing was left but the comparatively small sheets of saline water which we find to-day.

Dainelli states that the stratified clay deposits in the Tankse-Drugub valley, as well as those in the Upper Indus valley, were deposited in lakes during his third glacial period.† I could prove that at the western end of lake Pangong the old lake sediments are covered by moraine deposits. When during the later glacial periods the glaciers advanced from the tributary valleys, pushing their snouts often into the main valleys and right across them, the melting waters were often dammed up and could find no outlet, so that the valleys were transformed into lakes. The same phenomenon is still going on to-day. I only remind the reader here of the lake which was dammed up in the Upper Shyok valley by the Chong Kumdun.‡ Many lakes of this kind were in existence during the Ice-Age. We can recognize their remnants in the old stratified clay deposits which are so widely distributed across the Tibetan plateaux (Pl. 8).

Our knowledge of the former glaciation of the Sino-Tibetan Ranges is very meagre. According to Tafel's studies glaciers once advanced through the Upper Yangtze valley. In South-Eastern Tibet the glaciers ended at 3000 m., while their snouts are at present as high as 4500 m. When referring to his journey from the sources of the Hwang Ho to the Upper Yangtze Valley Tafel points out that the longitudinal valleys were almost completely scooped out by the former enormous Tibetan Highland glaciers ("Inlandgletschermassen").§

* *Geographical Review* (New York, 1929), xix.

† Dainelli, 'Studi sul Glaciale,' vol. i, pp. 383 *et seq.*

‡ *The Himalayan Journal*, vol. i, No. 1; "The Shyok Dam in 1928," by F. Ludlow; "Indus Floods and Shyok Glaciers," by Major Kenneth Mason; and *G. J.*, 74, 1929, p. 383, "The Glaciers of the Upper Shyok in 1928," by Captain Malcolm Sinclair.

§ *Ztschr. Ges. Erdkunde* (Berlin, 1908), pp. 389-393.